SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 13
JULY 1, 1970

W70-05044 -- W70-05546

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 13
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

THE ROLE OF COAGULATION IN NATURAL WATERS,
Harvard University, Cambridge, Mass. Div. of Engineering and Applied Physics.
For primary bibliographic entry see Field 02K.
W70-05472

02. WATER CYCLE

2A. General

ENERGY AND MOISTURE BALANCES OF AN ALPINE TUNDRA IN MID-JULY,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung, Ronald N. Kickert, Gerald L. Potter, and Stanley W. Swarts.
Arctic and Alpine Research, Vol 1, No 4, p 247-266, 1969. 20 p, 16 fig, 2 tab, 47 ref.

Descriptors: *Energy budget, *Tundra, *Mountains, *California, Heat balance, Heat budget, Solar radiation, Albedo, Weather, Evaporation, Evapotranspiration, Temperature, Thermoperiodism.
Identifiers: Alpine tundra, White Mountains (Calif).

The daytime budget of energy and moisture has been constructed for an alpine tundra at 37 deg 33 ft 50 in N, 118 deg 13 ft 45 in W at about 3,580 m elevation in the White Mountains of California during mid-July. Parameters observed were direct and diffuse solar radiation on a horizontal surface, on slopes of 45 deg and 90 deg for the cardinal directions, and albedo. Net radiation was measured over the tundra interface and the water surface of a pond. Radiant temperatures (or counterradiation) and the actual surface temperature (or terrestrial radiation) were utilized to derive 'environmental radiant temperature.' This index proved to be of much greater utility than air temperature. Other data included soil temperatures and logarithmic wind profiles. The disposition of net radiation (minus soil heat flux) via sensible and latent heat flux (evapotranspiration) were computed via the Bowen ratio and aerodynamic equations. A series of highly correlated empirical relationships between the data are presented, together with a daily budget of input and output. The data indicate that the alpine tundra undergoes one of the greatest energy fluctuations observed on this planet. (Knapp-USGS)
W70-05068

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
V. V. Dhruva Narayana, J. Paul Riley, and Eugene K. Israelsen.
Available from the Clearinghouse as PB-190 483, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report PRWG 56-1, Utah Water Research Laboratory, January 1969. 83 p. OWRR Project B-016-UTAH.

Descriptors: *Urban hydrology, *Simulation of urban hydrology, *Hydrologic models, *Electronic analog computer, *Storm drain design, *Flood frequency, *Urban parameters, *Runoff characteristics, Simulation, Watershed studies, Hydrology, Hydrologic research, Computer simulation, Surface runoff, Precipitation, Urban watershed, Equivalent rural watershed, Percentage impervious cover, Characteristic impervious length factor, Texas.
Identifiers: Waller Creek watershed, Austin (Tex).

In the synthesis of hydrograph characteristics of small urban watersheds, the distribution of water among the various phases of the runoff process is attempted by the concept of equivalent rural watershed. The urban parameters considered in the study are percentage impervious cover and characteristic impervious length factor. A mathematical model is developed for the equivalent rural watershed with precipitation as input. The hydrograph of outflow is obtained by chronologically deducting the losses due to interception, infiltration, and depression storages from precipitation and then routing through the watershed storage. This mathematical procedure is programmed on an analog computer and is tested with data from the Waller Creek watersheds, at Austin, Texas. In the verification process, watershed coefficients representing interception, infiltration, and depression storage are established by trial and error such that the simulated and observed hydrographs are nearly identical with a high statistical correlation. Sensitivity studies indicate the relative influence of the watershed coefficients on the runoff process. The watershed coefficients determined by model verification for each year of study are related to corresponding urban parameters.
W70-05118

COMPUTER SIMULATION OF THE HYDROLOGIC SYSTEM OF A MOUNTAIN WATERSHED,
Montana Water Resources Research Center, Bozeman.
For primary bibliographic entry see Field 07C.
W70-05125

EFFECTS OF BANK SEEPAGE ON FLOOD HYDROGRAPHS,
Kansas Water Resources Research Inst., Manhattan.
Ernest C. Pogge.
Available from the Clearinghouse as PB-190 575, $3.00 in paper copy, $0.65 in microfiche. Kansas State University Water Resources Research Institute Project Completion Report, Contribution No 33, 1968. 42 p, 7 fig, 5 tab, 2 ref, 2 append. OWRR Project No A-018-KAN.

Descriptors: *Hydrograph analysis, *Mathematical models, *Bank storage, Base flow, Floods, Recharge, Groundwater movement, Surface-groundwater relationships, Water levels, Aquifers, Alluvial channels, Computer programs, Computer models, Recession curves.
Identifiers: Bank seepage, Flood hydrographs.

Two analytical methods for determing the change in groundwater levels, bank seepage and the amount of bank storage that occurs at a particular location in an alluvial aquifer during the passage of a flood wave were used to develop bank seepage models for the digital computer. One of the models utilizes an asymmetric sine curve to approximate the flood-wave hydrograph. The other model utilizes linear segments to simulate the flood-wave hydrograph. Both models were developed for an idealized alluvial aquifer and for limited boundary conditions. The models were tested using the same input data for both and comparing simulated groundwater levels, bank seepage, and bank storage to verify the mathematical derivations and computer programs and show the advantages and disadvantages of each of the models. (Knapp-USGS)
W70-05126

RUNOFF FORECASTS BY LINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
Mikio Hino.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7146, p 681-702, March 1970. 22 p, 13 fig, 1 tab, append.

Descriptors: *Runoff forecasting, *Rainfall-runoff relationships, *Streamflow forecasting, *Statistical models, Probability, *Unit hydrographs, Statistical methods, Hydrograph analysis, Hydrographs, Hyetographs, Rainfall intensity, Frequency analysis.
Identifiers: Linear predictive filter (Statistical).

The optimal unit hydrograph is shown to be the weighted sum of each runoff component which constitutes the crosscovariance. Statistical properties of hydrological data such as autocovariance, crosscovariance, spectrum, coherence and phase angle are investigated to apply the prediction method practically. It is shown that the autocovariance of daily rainfall may be roughly approximated by the Dirac delta function. The crosscovariance of rainfall and runoff analyzed in this paper is composed of two runoff components of short and long periods. The coherence of rainfall and runoff is nearly unity for light rainfall suggesting that the rainfall-runoff process may be approximated by a linear system. On the other hand, the coherence becomes worse as the rainfall intensity increases; there is a gap of coherence in the middle frequency range. Examples of runoff prediction by the theory are given. (Knapp-USGS)
W70-05139

LAMINAR AND TURBULENT OVERLAND FLOW HYDROGRAPHS,
Cornell Univ., Ithica, N.Y.
James R. Morgali.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7069, p 441-460, February 1970. 20 p, 17 fig, 21 ref, append. FWPCA Research Grant WP-00948-02.

Descriptors: *Overland flow, *Mathematical models, *Computer models, Rainfall-runoff relationships, Hydrograph analysis, Unit hydrographs, Dimensional analysis, Laminar flow, Turbulent flow, Critical flow, Rainfall intensity.
Identifiers: *Kinematic wave theory.

A computer-solved mathematical model may be used to synthesize flow. An application of the kinematic flow assumptions is used for analysis of experimental overland-flow hydrograph data. The results of this analysis give an indication of flow regime, roughness, and the nature of the change from laminar to turbulent flow. The hydrographs are put in dimensionless form using the rainfall and the kinematic time to equilibrium as normalizing factors. Included is an anlaysis of a computer-solved mathematical model. The results from the data analysis are used in this model to synthesize a turbulent and a laminar hydrograph which compare favorably with the original experimental data. (Knapp-USGS)
W70-05152

MOVABLE BED MODEL FOR ALLUVIAL CHANNEL STUDIES,
Corps of Engineers, Omaha, Nebr.
For primary bibliographic entry see Field 02J.
W70-05192

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
Millard Hastay, and John S. Gladwell.
J Hydrol, Vol 9, No 2, p 117-135, 1969. 19 p, 2 fig, 8 tab, 9 ref.

Descriptors: *Weather modification, *Cloud seeding, Rain gages, Silver iodide, Snowfall, *Streamflow, Streamflow records, Statistical analysis, Atmospheric precipitation, *Runoff, *Evaluation, Streamflow forecasting, Mathematical analysis, Winter.
Identifiers: Snow gages, Stream gaging station, *Skagit River (Wash), Silver iodide generators.

During the winters of 1962-63 and 1963-64, cloud seeding operations were undertaken on the Skagit River, Wash, watershed. Conditions required that a statistical evaluation be made at the streamflow control level. A combination of least squares regression with principal components analysis was developed, requiring preliminary screening of variables using a liberal (0.10 level of significance) critical region, followed by the orthogonalization procedure of principal components. Final stepwise regression analysis using the principal component scored and the 0.05 level of significance followed. Tests were consistent with treating the residuals as Gaussian, homoscedastic, and nonautocorrelated. The analysis was replicated in various ways. Without exception, the excess of overpredicted flows for the full period of the experiment was significant at 0.01 or higher level. Whereas the excess in 1964 is invariably significant at the 0.005 or higher level, the 1963 excess would not be judged signficnt by itself at the 0.05 level. This is explained by a 5-fold increase in seeding between 1963 and 1964. Records of 2 yr subsequent to the period of seeding are analyzed; observed flows failed to show significant deviations from expected flows. Estimates indicated at least 15% runoff increase from seeding. (USBR)
W70-05221

MODELLING PARTIALLY PENETRATING RIVERS ON AQUIFER MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
Robin Herbert.
Ground Water, Vol 8, No 2, p 29-36, March-April 1970. 8 p, 9 fig, 10 ref.

Descriptors: *Surface-groundwater relationships, *Analog models, Water levels, Base flow, Discharge (Water), Induced infiltration, Model studies.
Identifiers: Aquifer models, Partially penetrating rivers.

A technique is presented for simulating partially penetrating rivers on two-dimensional resistance-capacitance network analog aquifer models. The method is tested against an analytic solution due to Boulton (1942). Several results are presented which can be used to estimate an approximate value for the steady state discharge of a well pumping near a partially penetrating river. (Knapp-USGS)
W70-05478

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
Adrian P. Visocky.
Ground Water, Vol 8, No 2, p 5-10, March-April 1970. 6 p, 7 fig, 12 ref.

Descriptors: *Storm runoff, *Base flow, *Monitoring, *Water quality, Leaching, Infiltration, Rainfall-runoff relationships, Surface-groundwater relationships, Electrical conductance, Hydrographs, Peak discharge.
Identifiers: Base flow estimation.

The feasibility of determining the groundwater contribution to stream flow during periods of storm runoff by continuous monitoring of a stream's electrical conductance was investigated. The groundwater contribution can be estimated if stream flow and the conductance of surface water and of groundwater are known. The conductance method was tested on a 95-square-mile basin in north-central Illinois. Continuous records of stream flow, stream-flow conductance, and groundwater stage within the basin were collected. A rating curve of base flow versus mean groundwater stage was constructed, and groundwater discharges determined from the rating curve were compared with those computed from conductance data. The conductance method normally gave a lower estimate of the groundwater contribution than did the rating-curve method. However, analyses of storms which were preceded by extended dry periods resulted in much lower estimates of groundwater discharge by the rating-curve method than by the conductance method. The conductance method offers a simple alternative for use in areas where observation wells are unavailable or where rating curves are difficult to construct. (Knapp-USGS)
W70-05481

REGIONAL GROUNDWATER FLOW-OLD WIVES LAKE DRAINAGE BASIN, SASKATCHEWAN,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-05485

2B. Precipitation

ON THE RELATION BETWEEN DROP SIZE AND CONCENTRATION OF TRACE ELEMENTS IN RAINWATER,
Frankfurt Univ. (West Germany). Institut fuer Meteorologie und Geophysik.
For primary bibliographic entry see Field 02K.
W70-05132

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
For primary bibliographic entry see Field 02A.
W70-05221

THE ECONOMIC IMPACT OF DROUGHTS ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
A. Vaughn Havens.
New Jersey Agricultural Experiment Station, College of Agriculture and Environmental Science, Rutgers - The State University, December 1969. 114p, 19 tab, 31 fig, 41 ref.

Descriptors: *Droughts, *Economic impact, *Hydrologic aspects, *Meteorology, Costs, Biochemical oxygen demand, Dissolved oxygen, River flow, Temperature, Nitrogen compounds, Effective precipitation, Water purification, Regression analysis.
Identifiers: Palmer Drought Index, Passaic Valley Water Commission.

The two objectives of this study are (1) to investigate the relationship between water treatment cost and selected hydrologic and meteorologic variables associated with, and indicative of, drought, and (2) to determine the effect of drought on water treatment cost. The variables studied were: economic-river water chemical treatment cost; hydrologic-biological oxygen demand, dissolved oxygen, stream flow, water temperature, and ammonia; and meterologic-Palmer Drought Index and precipitation. Time series and correlation analyses revealed some basic information on the simple relationships between all the variables. Graphic analysis was also utilized to determine the relationships between the various variables. Estimates of the cost of drought at the Passaic Valley Water Commission for the January 1961 - December, 1966, period. Extensive tables of data and graphs are included. (Grossman-Rutgers)
W70-05275

STATISTICAL ANALYSIS AS A FLOOD ROUTING TOOL,
Weather Bureau, Salt Lake City, Utah. Western Region.
For primary bibliographic entry see Field 02E.
W70-05316

PARK RANGE: ATMOSPHERIC WATER RESOURCES PROGRAM,
EG and G, Inc., Boulder, Colo., Environmental Services Operation.
For primary bibliographic entry see Field 03B.
W70-05317

2C. Snow, Ice, and Frost

PHYSICAL PROPERTIES AND INTERNAL STRUCTURE OF GREENLAND SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
Ukichiro Nakaya, and Daisuke Kuroiwa.
Report available from Cold Regions Research and Eng Lab, Hanover, New Hampshire 03755. Cold Regions Research and Engineering Laboratory Research Report 89, January 1970. 33 p, 25 fig, 1 tab, 21 ref. DA Task 1T061102B52A02.

Descriptors: *Snow, *Snowpacks, *Arctic, Density stratification, Physical properties, Glaciers, Firn, Bulk density, Density, Diffusivity, Porosity, Rheology, Permeability, Elasticity (Mechanical), Strength.
Identifiers: *Greenland, Snow properties.

Experiments were carried out near Thule, Greenland, on the correlation between the physical properties and internal structure of snow. About 150 snow samples obtained to 26 m depth were measured for elastic modulus, air permeability, unconfined compressive strength, and static compression and creep. The observed density profile curve deviated from the theoretical curve at a depth of 10 m and density of 0.52 g/cc, a value almost equivalent to the limiting density obtainable by simple mechanical packing. Therefore, further densification must proceed through plastic flow in grains. A similar critical depth was observed in the vertical distribution of Young's modulus. A positive correlation was found between Young's modulus and density, and an inverse correlation between average grain diameter and Young's modulus or density. There were reciprocal correlations between air permeability and density or unconfined compressive strength, and between the number of grains and their average diameters. Kozeny's constant of Greeland snow was obtained from air permeability values and the length of peripheries of cross sections of grains. Basal slip, buckling, cell or sub-grain formation, recrystallization and grain boundary migration occurring during plastic deformation of snow texture were observed by static compression of thin section snow under the microscope. (Knapp-USGS)
W70-05129

A HEAT BUDGET OF THE WATER IN BARROW STRAIT FOR 1962,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
A. Huyer, and F. G. Barber.
Marine Sciences Branch, Department of Energy, Mines and Resources, Manuscript Report Series No 12, Ottawa, Canada, 1970. 43 p, 11 fig, 8 tab, 61 ref.

Descriptors: *Heat budget, *Heat transfer, *Ocean circulation, *Arctic, *Alaska, Solar radiation, Advection, Cold regions, Sea ice.
Identifiers: *Barrow Strait (Canada).

A heat budget was computed for the water in Barrow Strait, Canada. Radiation and other meteorological observations were made on nearby Cornwallis Island. The oceanography and especially the water movements of the region are little known. A net water transport to the eastward occurs in Barrow Strait; however, the data are largely qualitative and, in the main, are restricted to the period of the navigation season. A strong (2 knot) westward moving current can occur close inshore in Barrow Strait off Resolute, at least for short periods of 2 to 3 days. A small westward movement occurs at the surface between Cornwallis and Griffith Islands with a general eastward movement throughout the remainder of Barrow Strait.

Although icebergs have been observed as far west as Barrow Strait, it is believed that the main surface drift is eastward. Due to topography this drift comprises water from the upper 150 m in the Arctic Ocean. As this water is close to the freezing point, the movement should contain little sensible heat. A consideration of the movement which likely occurs through Jones Sound and Smith Sound led to a similar conclusion, that water transport into Baffin Bay from the Arctic Ocean does not contribute significant sensible heat to Baffin Bay. (Knapp-USGS)
W70-05136

FOUNDATIONS AND SUBSURFACE STRUCTURES IN SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 08A.
W70-05302

ANNUAL REPORT NO. 1,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
Nobert Untersteiner, Phil Church, Gary Maykut, Roger Evans, and John Kelley.
Available from the Clearinghouse as AD-699 144, $3.00 in paper copy, $0.65 in microfiche. Report (Period: Oct 1, 1968-Sep 30, 1969), 1 Dec 69, 27 p.

Descriptors: *Sea ice, Arctic, Stress, Mathematical models, Turbulent boundary layers, Ablation, Cracks, Carbon dioxide, Albedo, Micrometeorology, Air-water interfaces.
Identifiers: Atmospheric temperature, Thickness.

The phase-out of routine collections of field data has enabled the Laboratory to concentrate on data analyses and publications. Three new projects, directly applicable to practical problems, have been initiated- (thermal cracks in sea ice, critical Richardson number and frictional coupling between air and ice, and the creep mechanism of polycrystalline ice). The outline of a plan to study the large-scale dynamics of sea ice was prepared under the code name AIDJEX (Arctic Ice Deformation Joint Experiment). Previous work has dealt with the stresses of air and water on the ice and with the exchange of heat between the three media. If this materializes, current activities would require little adjustment to be integrated into the overall objectives of AIDJEX.
W70-05313

ICE THICKNESS OBSERVATIONS, NORTH AMERICAN ARCTIC AND SUBARCTIC 1964-65, 1965-66. PART IV,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Michael A. Bileilo, and Roy E. Bates.
Available from the Clearinghouse as AD-699 328, $3.00 in paper copy, $0.65 in microfiche. Special Rept. No. CRREL-SR-43-Pt-4, Nov 69, 134 p.

Descriptors: *Arctic, *Ice, Measurement, Rivers, Networks, Sea ice, Weather forecasting, Lakes, Maps, Lake ice, Winter.
Identifiers: Remote areas, River ice, Alaska, Canada.

The report is fourth in a series of reports on lake and river ice land-fast sea ice records ice thickness observed throughout the North American arctic and subarctic during the 1964-65 and 1965-66 seasons. Information on ice surface conditions, dates of first ice, freeze-over and breakup, and detailed measurements of ice thickness across Alaskan rivers are also included. First reports from the Alaska National Guard on Ice thickness measurements on lakes and rivers in the remote regions of interior Alaska are presented. Analyses on maximum observed ice thicknesses reported during the two winters in North America and deviations from the mean ice thickness amounts measured across Alaska rivers between 1961 and 1966 were conducted.
W70-05314

THE EFFECT OF DISTURBANCE ON PERMAFROST TERRAIN,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Jerry Brown, Warren Rickard, and Donald Victor.
Available from the Clearinghouse as AD-699 327, $3.00 in paper copy, $0.65 in microfiche. Special Rept. No. CRREL-SR-138, Nov 69, 18 p.

Descriptors: *Permafrost, Stresses, *Soil investigation, Erosion, Degradation, Ice, Melting, Drainage, Foundations, Cracks, Buildings, Plants (Botany), Swamps, Damage, Penetration, Tundra, Earth moving equipment, Terrain analysis.
Identifiers: Peat, Arctic soils, Alaska, Fire damage.

The influence of surface cover on thaw penetration in alpine and arctic soils of Alaska was determined. Several manipulated treatments were employed: removal of all vegetation, mulching, shearing and fire. Thaw and subsidence more than doubled on the bare and sheared plots and increased up to 50% on the burned areas. Bulldozing of and traffic over ice-rich permafrost terrain resulted in considerable erosion and thaw.
W70-05315

A PHOTOELECTRIC SNOW PARTICLE COUNTER,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
R. A. Schmidt, and R. A. Sommerfeld.
Western Snow Conference, Salt Lake City, Utah. Proceedings, April 15-17, 1969, v. 37, p 88-91.

Descriptors: *Instrumentation, *Snow, Precipitation gage, Bridge (Electronic), *Snowfall, Colorado.
Identifiers: Snow particle counter.

To count individual snow particles transported by wind, an instrument was designed using a light beam and photo-transistors. Two light sensors were incorporated to determine particle speed. An integrated circuit operational amplifier provides an output from the photo-transistor bridge circuit. The output is recorded on magnetic tape. (Schmidt-Forest Service).
W70-05457

EXPERIMENTAL LARGE-SCALE SNOW AND ICE MAPPING WITH COMPOSITE MINIMUM BRIGHTNESS CHARTS,
National Environmental Satellite Center, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-05522

2D. Evaporation and Transpiration

EVAPORATION NORMS FROM WATER RESERVOIRS,
State Hydrological Inst., Moscow (USSR).
A. P. Braslavskii, and Z. A. Vikulina.
GIMIZ Leningrad 1954, Engl. Transl. Israel Program for Scientific Translations, Jerusalem 1963, 217 p, 24 fig., 94 tab., 77 ref, append.

Descriptors: *Evaporation, *Reservoirs, *Heat balance, Temperature, Climatology, Climatic data, Heat budget, Environmental effects, Climatic zones, Reservoir evaporation, Air-water interfaces, Evaporation pans, Hydrologic cycle, Vapor pressure, Latent heat, Winds, Wind velocity, Turbulence, Humidity, Dew point.
Identifiers: USSR Reservoirs.

The monograph is the result of research carried out by the GGI (State Hydrological Institute) aimed at developing a method for the calculation of evaporation from the surface of reservoirs. Methods are presented for calculating the various meteorological elements of the hydrologic regime of water reservoirs, including evaporation, by taking into consideration the water balance and the relevant physical characteristics of the reservoir. The results of such calculations of evaporation have been mapped and a series of tables and nomograms, simplifying the calculations are given. A heat balance method for calculating the temperature of a reservoir was developed and computation of necessary parameters for different regions of the USSR presented. (Novotny-Vanderbilt)
W70-05056

PHYSICAL, METEOROLOGICAL, AND HYDROLOGIC ASPECTS OF EVAPOTRANSPIRATION,
Clemson Univ., S.C. Water Resources Research Inst.
Jerry R. Lambert.
Available from the Clearinghouse as PB-190 573, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute, Clemson University, Report No. 14, p. 1-59, March 1970. 20 fig, 1 tab, 5 ref. OWRR Project B-001-SC.

Descriptors: *Evapotranspiration, *Lysimeters, *Transpiration control, *Water yield improvement, Soil water movement, Energy budget.
Identifiers: Plant water physics.

The flow of water through an individual plant was treated as a hydraulic system. Unsaturated flow of water to a plant rate was assumed. A solution predicting the rate of soil moisture extraction by a single plant was developed. Experimental data did not confirm this solution, probably because of error in establishing the experimental parameter. A 1 inch-thick acrylic infrared filter was used over a weighing lysimeter in determining the effects of reducing infrared radiation on evapotranspiration. An energy budget and experimental data confirmed the reduction of evapotranspiration rates over a 48-hour period to one-quarter that of the control lysimeters. The use of phenylmercuric acetate for transpiration control and possible subsequent increased water yield was attempted on a 3.5-acre watershed. Both ground- and aerial-operated spraying reflected only short term (four week) effects as measured by pressure infiltration on short-leaf and loblolly pine. (Lambert-Clemson)
W70-05123

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
Calvin C. Easterbrook.
Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Price 65 cents. Bureau of Reclamation Research Report No. 18, 1969. 58 p, 38 fig, 12 ref, 5 append. USBR Contract 14-06-D-5764.

Descriptors: *Evaporation, *Waves (Water), *Reservoir evaporation, Evaporation control, Waves, Wind tunnels, Wind velocity, Wind speed, Water vapor, Water temperature, Lakes, Laboratory tests, Field investigations.
Identifiers: *Evaporation coefficient, *Wave height, Evaporation tanks, Lake Hefner (Okla), Wave tanks, Mass transport.

The evaporation rate from a water surface is shown to be greatly affected by surface waves in laboratory and field tests. Laboratory experiments were made using a large wave tank-wind tunnel apparatus in which both wind speed and wave parameters could be controlled. The apparatus simulates wave conditions on large bodies of water with fetches up to a mile or more. Tank experiments indicate certain combinations of wind speed and well-developed waves produce an evaporation rate lower than the rate under similar wind conditions with no waves present. Investigations of air flow over the waves show that, as wave heights increase, regions of dead air are observed leeward of wave crests, and vortices appear in the wave troughs. The partially trapped air apparently forms an effective barrier to the vertical transport of water vapor. Wave and evaporation measurements at Lake Hefner, Oklahoma, were very similar to the

laboratory measurements. The Lake Hefner data were adjusted to previously measured evaporation coefficient relationships derived from water and energy budget measurements. The resulting evaporation coefficient curve is believed to give an improved measure of the instantaneous evaporation rate from Lake Hefner under given conditions for wind speed, water surface temperature, and ambient humidity.
W70-05208

THE CLIMATOLOGY OF SOIL MOISTURE, EVAPORATION, AND NON-MOISTURE STRESS DAYS FOR CORN IN IOWA,
Environmental Science Services Administration, Rockville, Md.; and Iowa State Univ., Ames.
Robert F. Dale.
Agricultural Meteorology, Vol 5, No 2, p 111-128, March 1968. 12 fig, 7 tab, 12 ref.

Descriptors: *Climatology, *Corn (Field), *Crop production, *Soil moisture, *Evaporation, Moisture availability, Moisture stress, Evapotranspiration, Weather, Precipitation (Atmospheric), Iowa, Corn Belt, Estimating, Phenology, Soil-water-plant relationships, Variability.
Identifiers: *Potential evapotranspiration, *Non-moisture stress.

The study is concerned with the possibility of utilizing for regional agricultural planning a method which considers the interaction upon corn crops of potential evapotranspiration, soil moisture, and ease of extraction of available water. Climatology of the number of days with no moisture stress in the critical growth period of corn is given for four Iowa locations. Climatology of the input variables is described for these same four stations. Input variables consist of evaporation, precipitation, and soil moisture under corn. Using the non-stress day climatology it was demonstrated that areas of higher than average precipitation had a higher frequency of unfavorable weather and lower corn yields caused by moisture stress. (Carr-Arizona)
W70-05286

OBSERVED AND ESTIMATED EVAPOTRANSPIRATION IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta). Research Station.
E. H. Hobbs, and K. K. Krogman.
American Society of Agricultural Engineers, Transactions, Vol 11, No 4, p 502-503, 507, July-August 1968. 3 p, 2 fig, 8 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Irrigation, *Irrigation practices, *Estimating, Semiarid climates, Grasslands, Wheat, Alfalfa, Sugar beets, Potatoes, Grasses, Data collections, On-site investigations, Scheduling, Soil moisture.
Identifiers: *Alberta (Canada).

Recent studies of consumptive use of water by crops have related measured evapotranspiration to various meteorological parameters. These relationships provide a method of estimating evapotranspiration for irrigation scheduling and applying the data to other prairie areas, thus eliminating the measurement of evapotranspiration at each locality. Measured evapotranspiration is given for five crops (alfalfa, grass, potatoes, soft wheat, and sugar beets) and the data are compared with potential evapotranspiration. Transfer value of the data is discussed, based on the ratio of measured to potential evapotranspiration. (Carr-Arizona)
W70-05293

TRANSPIRATIONINTENSITY AS RELATED TO VEGETATION ZONATION IN THE WHITE MOUNTAINS OF CALIFORNIA,
California Univ., Los Angeles. Dept. of Botanical Sciences.
H. A. Mooney, Robert Brayton, and Marda West.
American Midland Naturalist, Vol 80, No 2, p 407-412, October 1968. 1 fig, 2 tab, 3 ref.

Descriptors: *Transpiration, *Elevation, *Vegetation, *Desert plants, *Conifers, Altitude, Arid lands, California, Soil moisture, Water loss, Environmental effects, Greenhouses, On-site data collections, Tundra, Climatic zones.
Identifiers: *Transpiration rates, *Vegetation zones, *Growth forms, *Deciduous plants,*Evergreens, White Mountains (Calif).

Transpiration rates weremeasured both insitu and in a greenhouse environment for native plants growing at 5,000 to 12,000-foot elevations in the White Mountains of California. Vegetation zones included in the study ranged from desert scrub to alpine tundra. Highest rates of transpiration occurred in two desert shrub species; lowest rates were in the conifers of the two middle zones. Thus there is no clear sequence of rate intensity as related to elevation. However, a relationship does appear between transpiration rate and growth form. Desert summer deciduous shrubs transpire intensely during growth periods when water is available. When water is limited, there is a loss of leaves, thereby decreasing the amount of transpiring surfaces. Evergreen desert shrubs have a much lower rate of water loss, as do evergreens at higher elevations. (Carr-Arizona)
W70-05299

EVAPORATION AND ITS SUPPRESSION BY CHEMICAL FILMS AT LAKE HEFNER,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03B.
W70-05300

2E. Streamflow and Runoff

STRATIFIED RESERVOIR CURRENTS: PART I, ENTERING STREAMFLOW EFFECTS ON CURRENTS OF A DENSITY STRATIFIED MODEL RESERVOIR,
Oregon State Univ., Corvallis. Engineering Experiment Station.
E. H. Elwin, and L. S. Slotta.
Bulletin No. 44, October, 1969. 97 p, 29 fig, 31 ref, 3 append.

Descriptors: *Stratification, *Reservoir, *Model studies, Flow rate, Temperature, Reynolds number.
Identifiers: Density profiles, *Current patterns.

An experimental study of entering streamflow effects on currents of a density stratified model reservoir was made. Experiments were performed using various concentrations of a sodium chloride solution to provide linear density stratification. Flow field current patterns and velocities were determined photographically. For the range of values tested, the entering model streamflow created two possible main inflow density currents in the model reservoir. The upper inflow current increased its magnitude and lower inflow current decreased its magnitude as the model streamflow Reynolds number increased. These currents could be described in terms of V1 max and V3 max, the maximum inflow current velocity and maximum mixing current velocity respectively; h1 and h3, the depth of these two currents respectively; v is the kinetic viscosity of reservoir fluid; V is the inflow velocity; D/ (D-h), is the density scaling factor; and (rho max) and (rho o) is the maximum density and initial density of the fluid and b is the width of inflow current. The lower inflow current will no longer occur at a model streamflow number greater than Vb/v = 150000 ((D-h)/D). The interaction between two reservoir density currents created a significant reinforcement of both currents. (See W70-05049). (Upadhyaya-Vanderbilt)
W70-05048

STRATIFIED RESERVOIR CURRENTS: PART II, THE NUMAC METHOD FOR NON-HOMOGENEOUS UNCONFINED MARKER-AND-CELL CALCULATIONS,
Oregon State Univ., Corvallis. Engineering Experiment Station.
M. D. Terry, H. T. Mercier, and L. S. Slotta.
Bulletin No. 44, October 1969. 61 p, 17 fig, 12 ref.

Descriptors: *Hydrodynamics, Density, Reservoirs, *Model studies.
Identifiers: *Algorithm, Salt water wedge, Over-relaxation factor, *Boundary conditions, Velocity profiles, Viscosity effect.

A marker and cell method was employed in a system containing two discrete fluids using a mixed Eulerian-Lagrangian scheme. The velocity and pressure were considered as Eulerian variables and found at the mesh points of a fixed grid. The density was considered a Lagrangian variable and was localized to fluid particles. The method may be used for computations involving nonhomogeneous, incompressible viscous fluids. The current version of NUMAC admits only boundaries that are expressible in terms of the grid, i.e., those which have been 'rectangularized'. If circular or oblique boundaries are desired, the boundary must be approximated in terms of grid. Standard techniques in the numerical solution of partial differential equation may then be used to apply to the oblique or circular boundary conditions in the boundary cells. New boundary conditions which are useful in hydrodynamic or oceanographic simulation are presented. A flow chart and a listing for those interested in implementing the method are included. (See W70-05048). (Upadhyaya-Vanderbilt)
W70-05049

GRAPHICAL SOLUTION OF HYDRAULIC JUMP,
Utah State Univ., Logan. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05060

LIMIT SLOPE IN UNIFORM FLOW COMPUTATIONS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05061

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
For primary bibliographic entry see Field 08B.
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-05063

MANNING FORMULA -- A MISNOMER,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 08B.
W70-05064

RIVER CHANNEL PATTERNS,
Central Water and Power Research Station, Poona (India).
Shrikrishna V. Chitale.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7038, p 201-221, January 1970. 21 p, 15 fig, 3 tab, 15 ref, append.

Descriptors: *Channel morphology, *Meanders, *Drainage patterns (Geologic), Geomorphology, Rivers, Braiding, Deposition (Sediments), Sediment transport, Sediment load, Bed load.
Identifiers: River channel patterns.

River channel patterns of various types are described and defined. Data for 42 rivers are collected in respect to meander and channel characteristics. Relationships are statistically determined between tortuosity ratio and important channel characteristics. Similar equations are evolved for the ratio of meander belt to channel width. These two ratios define shape and size of a meander. Conditions when channels become straight or meandering are described and it is shown that meandering helps the channel to reach final stability. (Knapp-USGS)
W70-05065

INTEGRATING-FLOAT MEASUREMENTS AT LOW VELOCITIES,
Missouri Univ., Columbia. Dept. of Civil Engineering; and Tennessee Valley Authority, Norris. Hydrology Lab.
For primary bibliographic entry see Field 07B.
W70-05066

GAZETTEER OF HYDROLOGIC DATA FOR THE RIVER ROUGE BASIN, SOUTHEASTERN MICHIGAN,
Geological Survey, Lansing, Mich.
R. L. Knutilla.
Corps Engineers Southeastern Michigan Water Resources Study, Technical Paper No 1, March 1969. 84 p, 3 fig, 11 tab.

Descriptors: *Water resources, *Surface waters, *Michigan, Data collections, Hydrologic data, Streamflow, Discharge (Water), Water yield, Water quality, Runoff, Low flow, Base flow, Duration curves, Droughts.
Identifiers: *River Rouge (Mich).

Data are compiled for use in the formulation of a plan for the optimum development of the water resources of the southeastern Michigan area. The overall study encompasses an area of about 5,400 square miles. This report is on the River Rouge basin. Streamflow, physiographic, and other data on waters in the basin are presented. Summaries include the following data: station description, table of monthly and yearly mean discharge, table of monthly and yearly runoff, table of yearly discharge, and summaries of flow characteristics including flow duration, low flow, high flow, and deficient discharge. (Knapp-USGS)
W70-05070

WILLAMETTE RIVER AT LAMBERT BEND, OREGON- FLOODFLOW CHARACTERISTICS OF THE PROPOSED GREENACRES ROAD CROSSING,
Geological Survey, Portland, Oreg.
D. D. Harris.
Geological Survey Open-file report, April 1969. 10 p, 2 fig, 5 ref.

Descriptors: *Floods, *Oregon, *Bridges, *Stage-discharge relations, *Backwater, Flood control, Hydraulics, Civil engineering, Channel morphology, Profiles, Flood forecasting, Flood plains.
Identifiers: Willamette River (Ore), Backwater curves.

The proposed crossing of the Willamette River, Oregon, at Lambert Bend involves a 2.3-mile-wide flood plain. Two of the three principal tangents of the crossing will include bridges that will span the main channel and an overflow channel of the river. A design headwater elevation of 100.0 feet (upstream from the proposed constriction) will result in a discharge of 195,000 cfs. The main channel bridge does not contribute any backwater at this elevation. A discharge of 195,000 cfs occurred on the average of once every 3 years prior to 1941. The flood of December 1964 resulted in a discharge of 320,000 cfs at the proposed bridge site. With additional storage now available from three new reservoirs, an equivalent flood event could now be reduced to 261,000 cfs. With this flow, the constricted headwater elevation (at sec. 1) would reach 105.1 feet which includes 0.5 foot of backwater from the overflow bridge. The main channel bridge does not add any significant amount of backwater to this elevation. Before regulation, 261,000 cfs occurred on the average of once every 5 years. (Knapp-USGS)
W70-05072

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

RUNOFF FORECASTS BYLINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05139

CHANNEL SLOPE EFFECT ON PEAK DISCHARGE OF NATURAL STREAMS,
Washington Suburban Sanitary Commission, Hyattsville, Md., and Greenhorne and O'Mara, Inc., Riverdale, Md.
Charles L. Armentrout, and Robert B. Bissell.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7052, p 307-315, February 1970. 9 p, 3 fig, 1 tab, 9 ref.

Descriptors: *Peak discharge, *Runoff forecasting, *Small watersheds, Mathematical studies, Rainfall-runoff relationships, Discharge (Water), Routing, Floods, Flood forecasting, Streamflow forecasting.
Identifiers: Channel slope method.

The 'Channel Slope Method' provides a reasonable approach to the apparent need for a reasonable method of computing peak runoff rates for natural streams. Stream runoff data from the U. S. Geological Survey were correlated with the slope of the stream channel. The data were plotted on logarithmic paper with stream channel slope in feet per mile as abscissa and unit runoff in cubic feet per second per acre as ordinate. A straight line envelopes all the plotted points and gives the equation of the unit runoff for a particular recurrence interval. A conservative estimate of the peak discharge for a given recurrence interval may be made by this method. (Knapp-USGS)
W70-05141

VARIATION IN LAG TIME FOR NATURAL CATCHMENTS,
New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering.
Arthur J. Askew.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7051, p 317-330, February 1970. 14 p, 4 fig, 12 ref, append.

Descriptors: *Routing, *Flood routing, *Rainfall-runoff relationships, Hydrograph analysis, Unit hydrographs, Hydrographs, Runoff forecasting, Streamflow forecasting, Flood forecasting.
Identifiers: Lag (Runoff), Australia.

Lag time for a catchment is shown to be a variable which is strongly correlated with flood magnitude. Values for various parameters of rainfall and runoff were derived from the analysis of records for five small catchment areas. Lag time is defined as the time between the centers of mass of excess rainfall and direct runoff. Weighted mean discharge is used as the measure of average streamflow magnitude. No significant correlation is found between the lag and various characteristics of the areal and temporal distribution of rainfall. Therefore, the lag-weighted mean discharge equations best represent the variable lag time for the catchments studied. (Knapp-USGS)
W70-05142

CHARACTERISTICS OF SELF-AERATED FLOWS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05143

LINEAR PROPORTIONAL WEIRS,
Regional Engineering Coll., Rourkela (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-05146

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 07C.
W70-05147

EFFECT OF FLUME WIDTH ON BED-FORM CHARACTERISTICS,
Hydraulics Research Station. Wallingford (England).
For primary bibliographic entry see Field 02J.
W70-05150

RIPPLE CONCENTRATION AND FRICTION FACTOR,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05154

VERTICAL TRANSFER IN OPEN CHANNEL FLOW,
Geological Survey, Fort Collins, Colo.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05160

FLOOD PEAKS FROM SMALL SOUTHWEST RANGE WATERSHED,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.
Kenneth G. Renard, John C. Drissel, and Herbert B. Osborn.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7161, pp 773-785, March 1970. 13 p, 8 fig, 7 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Peak discharge, Rainfall intensity, Base flow, Meteorology, Frequency analysis, Runoff forecasting, Flood forecasting, Streamflow forecasting, Statistical methods, Discharge (Water), Routing, Hydrograph analysis, Time series analysis.
Identifiers: Flood peaks, Peak flow.

Runoff on the 67-sq-mile Alamogordo Creek Experimental Watershed in northeastern New Mexico is generated from storm precipitation with greatly differing characteristics. The largest peak discharges occurred from a combination of convective heating and weak summer cold fronts. Thunderstorms within frontal systems have produced large peak discharges and runoff volumes, whereas the long-duration summer frontal storms have produced appreciable volumes of runoff, but much lower peak discharges. For a storm duration of less than six hours, the point precipitation frequencies appear to be higher than those published by the U.S. Weather Bureau. The data show the importance of watershed rainfall values as compared to single point values. The five largest runoff events during the 14 yr-record are compared and discussed in relation to precipitation differences. By extrapolation of the available data, using a log-normal frequency distribution, the 20-yr flood was estimated to be 8,700 cfs. (Knapp-USGS)
W70-05163

WATER RESOURCES OF THE YELLOW MEDICINE RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
R. P. Novitzki, W. A. Van Voast, and L. A. Jerabek.
Geological Survey Hydrologic Investigations Atlas HA-320, 3 sheet, 1969. Text, 27 fig, 6 tab, 6 ref.

Descriptors: *Water resources, *Minnesota, Groundwater, Surface waters, Water resources development, Water supply, Water yield, Lakes, Streams, Aquifers, Recreation, Hunting, Fishing, Trapping.
Identifiers: Yellow Medicine River (Minn).

The water resources of the Yellow Medicine River Watershed, Minnesota are described in a 3-sheet Hydrological Atlas consisting of geological cross sections, block diagrams, small-scale maps, summary data tables, hydrographs, and duration curves. Lakes are shallow and best suited for hunting and trapping. Groundwater yield is sufficient for present and projected needs. Surface water use is less than 1% of annual flow, indicating a large potential development. (Knapp-USGS)
W70-05168

FLOOD PLAIN INFORMATION - CANYON CREEK AT JOHN DAY AND CANYON CITY, OREGON.
Corps of Engineers, Walla Walla, Wash.
For primary bibliographic entry see Field 04A.
W70-05171

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, CUYAHOGA AND SUMMIT COUNTIES, OHIO.
Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-05172

ON THE EFFECTS OF SUSPENDED SEDIMENTS TO THE BED ROUGHNESS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-05188

MACROTURBULENT FLOW IN STEEP OPEN CHANNELS WITH HIGH NATURAL ROUGHNESS,
For primary bibliographic entry see Field 08B.
W70-05189

A STUDY OF THE ROUGHNESS OF CONCEPTUAL RIVER SYSTEMS OR WATERSHEDS,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 08B.
W70-05190

UNIFORM FLOW IN IDEALIZED CHANNEL-FLOOD PLAIN GEOMETRIES,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05191

BOTTOM SHEAR MEASUREMENT IN AN OPEN CHANNEL FLOW,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
For primary bibliographic entry see Field 02J.
W70-05193

EXPERIMENTAL STUDY OF FLUME-BED ROUGHNESS,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02J.
W70-05194

THE EFFECT OF SAND RIPPLES ON THE INCREASE OF RIVER BED ROUGHNESS,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Hydraulics and Hydrology.
For primary bibliographic entry see Field 02J.
W70-05195

OBSERVED FORMS OF BED ROUGHNESS IN AN UNSTABLE GRAVEL RIVER,
Research Council of Alberta, Edmonton.
V. J. Galay.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A11, p 85-94, 1967. 10 p, 6 fig, 2 tab, 7 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Sounding, *Aerial photography, Rivers, Bed load, Dunes, Gravels, Sands, Particle size, Turbulent flow, Discharge (Water), Channel morphology.
Identifiers: *Canada, Alberta, North Saskatchewan River.

Echo-sounder measurements on an unstable gravel river in Alberta, Canada, indicate that minor bed forms develop on the river bed during high flow conditions and high bed-load transport. The wavelength of these bed forms appears to decrease with an increase in flow intensity and depth, for relatively small values of depth to grain size. Air photographs of this river reveal that the major bed forms (bars) are crescent-shaped with horns pointing downstream. (Knapp-USGS)
W70-05196

DETERMINATION OF ROUGHNESS COEFFICIENTS FOR VERY IRREGULAR RIVERS WITH LARGE FLOODPLAINS,
Institute for Water Resources, Belgrade (Yugoslavia).
Stevan Bruk, and Zvonimur Volf.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A12, p 95-99, 1967. 5 p, 3 fig.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Flood plains, *Vegetation effects, Mannings equation, Regression analysis, Channel morphology, Model studies, Hydraulic models.
Identifiers: Yugoslavia, Tamish River.

The channel geometry, total discharge and slope are known along a reach of the Tamish River, Yugoslavia, a very irregular river with a large floodplain. The reach is divided into sections, and each section is subdivided into main channel and several strips of the floodplain covered by definite types of vegetation. The sum of partial discharges for each strip, expressed by the Manning equation, equals the total discharge for each section. The only unknown variables of the equations are the roughness coefficients, corresponding to the main channel and to the types of vegetation on the floodplains. As the number of equations greatly exceeds the number of unknown variables, the method of least squares can be applied to obtain the most reliable values of the roughness coefficient, taking into consideration that the total loss of head between the first and last section of the reach must be equal to its measured value. Roughness coefficients for floodplains under grass, planted trees and natural forest were determined by means of computer calculations. (Knapp-USGS)
W70-05197

COLUMBIA RIVER BED FORMS,
Washington Univ., Seattle. Dept. of Geology; and Washington Univ., Seattle. Dept. of Oceanography.
John T. Whetten, and Timothy J. Fullam.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A14, p 107-114, 1967. 8 p, 7 fig, 1 tab, 4 ref. NSF Grant GP-3591; AEC Contract No AT (45-1)-1725 (RLO-1725-93).

Descriptors: *Channel morphology, *Roughness (Hydraulic), *Sand waves, *Columbia River, Currents (Water), Winds, Waves (Water), Bed load, Sediment transport, Sounding, Surveys, Alluvial channels.
'dentifiers: Seismic profiler.

Large sand waves on the bed of the lower Columbia River have been examined with a seismic profiler. The sand waves vary in size and shape; the largest are up to 200 m long and 5.5 m high. In Bonneville Reservoir, sand waves migrated downstream at a rate of 0.7 m/day during high water discharge in 1966 when bottom current velocities were 50-60 cm/sec. The rate of forward movement decreased with decreasing discharge. Some sand waves are subaerially exposed at low discharges of the river, and are modified by the wind. In areas where wind direction is nearly the same as water current direction, the wind-modified sand waves tend to be elongated and flattened. (Knapp-USGS)
W70-05198

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
For primary bibliographic entry see Field 08B.
W70-05199

EFFECT OF BEDLOAD MOVEMENT ON THE ROUGHNESS COEFFICIENT VALUE,
Hydraulic Research Inst., Bratislava (Czechoslovakia).
For primary bibliographic entry see Field 02J.
W70-05200

ABOUT THE ROUGHNESS IN ALLUVIAL CHANNELS WITH COMPARATIVELY COARSE BED MATERIALS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 02J.
W70-05201

SOME EXPERIMENTAL OBSERVATIONS ON FREE SURFACE SHEAR FLOW OVER A WAVY BOUNDARY,
Ecole Polytechnique, Montreal (Quebec); and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05202

RESISTANCE TO FLOW IN FIXED-BED CHANNELS WITH THE INFLUENCE OF CROSS-SECTIONAL SHAPE AND FREE SURFACE,
Genoa Univ. (Italy). Inst. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05203

THE ANALYSIS AND ESTIMATES OF ENERGY LOSSES BY INSTANTANEOUS VELOCITY DISTRIBUTION OF STREAMS WITH MOVABLE BED,
State Hydrological Inst., Leningrad (USSR).
N. S. Znamenskaya.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A4, p 27-31, 1967. 5 p, 3 fig, 7 ref.

Descriptors: *Sediment transport, *Bed load, *Turbulent flow, Regime, Dunes, Roughness (Hydraulic), Model studies, Mathematical models, Hydraulic models.
Identifiers: Bed load (Kinematic structure), Movable-bed channels.

The kinematic structure of turbulent streams with movable beds is discussed. Analysis of the velocity distribution images for dunes of different forms yielded energy losses and the necessary empirical relationships to characterize eddy formations and turbulence parameters. Energy losses were determined from Stock's formula of energy dissipation rate. Empirical relationships were used for hydrodynamic estimation of energy losses. Energy losses were determined by the proposed method and the results were compared with energy losses obtained from stream slope. The results of comparison are satisfactory and confirm the method. (Knapp-USGS)
W70-05204

INDUCTIVE APPROACH TO PHASES OF MOBILE-BED ROUGHNESS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
T. Blench.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967. Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A3, p 18-26, 1967. 9 p, 4 fig, 13 ref.

Descriptors: *Bed load, *Sediment transport, *Turbulent flow, Mathematical models, Parametric hydrology, Regime, Dimensional analysis, Model studies, Hydraulic models, Roughness (Hydraulic).
Identifiers: Bed load models (Conceptual).

The status of 'evolution of the river bed' and 'sediment transport' in the IHD Program is discussed. A major weakness in the combined topics is seen to be the gross discordance among competitive bed-load transport formulas, which are flow formulas expressed with the bed-load transport explicit in the roughness factor. Discordance are believed to arise from reliance on deduction from speculative premises to the exclusion of physical considerations. An inductive attack on the formula problem is outlined, with explanations. An orientation of research is proposed to suit. (Knapp-USGS)
W70-05205

STATISTICAL ANALYSIS AS A FLOOD ROUTING TOOL,
Weather Bureau, Salt Lake City, Utah. Western Region.
Robert J. C. Burnash.
Available from the Clearinghouse as PB-188 744, $3.00 in paper copy, $0.65 in microfiche. Technical memo., WBTM-WR-47, Dec 69, 12 p.

Descriptors: *Floods, *Flood routing, *Statistical methods, Flood plains, Drainage, Storage, *Hydrographs.
Identifiers: Conecuh River, California.

The use of statistics as an aid to flood routing analysis is referred to by Linsley, Kohler and Paulus. It is pointed out that coefficients of the Muskingum flood routing technique can be derived statistically. Requirements of their equation are given. This requirement precludes use of any parameters which are not linear for such parameters cannot maintain volumetric continuity except at a single level discharge.
W70-05316

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming Univ., Laramie. Water Resources Research Inst.
For primary bibliographic entry see Field 07C.
W70-05464

CELL METHOD FOR COMPUTING LAKE CIRCULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05482

RESISTANCE TO FLOW OVER TWO-DIMENSIONAL STRIP ROUGHNESS,
Roorkee Univ. (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05483

DYNAMIC EQUATIONS FOR STEADY SPATIALLY VARIED FLOW,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05484

AVERAGE FLOW OF MAJOR STREAMS IN FLORIDA,
Geological Survey, Tallahassee, Fla.
W. E. Kenner, E. R. Hampton, and C. S. Conover.
Florida Bureau of Geology Map Series No 34, 1969. Text, 1 map.

Descriptors: *Streamflow, *Florida, Mapping, Discharge (Water), Rivers, Streams, Lakes, Canals, Data collections, Hydrologic data.
Identifiers: Florida streamflow.

In Florida a major stream as used in this study is one that has an average flow of at least 1,000 cfs. Based on estimated flows at mouths or outlets, Florida has 11 major streams. In general, the drainage basins in northern Florida are large compared with those in southern Florida; topographic relief is greater, evaporation rate is lower, lakes are fewer, and the land is developed to a lesser degree. In general, therefore, average flow of streams in northern Florida is greater than that for streams in southern Florida. Four of Florida's five largest streams are in northern Florida. They are the Apalachicola, Suwannee, Choctawhatchee, and Escambia Rivers. The third largest stream, the St. Johns River, drains both southern and northern Florida. Except for the St. Johns River, all five of the largest rivers derive flow from beyond the borders of Florida. At the Florida line the average flow of the Apalachicola River is 22,000 cfs, or about 14,000 mgd. In southern Florida, streams for the most part are poorly developed and most of the drainage is through a system of canals. (Knapp-USGS)
W70-05486

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 80 p, 3 fig, 1 tab, 6 ref, append.

Descriptors: *Floods, *Hydrologic data, *Data collections, *Texas, *Urbanization, Rainfall-runoff relationships, Runoff, Streamflow, Hydrographs, Storm runoff.
Identifiers: *Dallas (Texas), *Urban hydrology.

This report presents the basic hydrologic data collected during the 1967 water year (October 1, 1966, to September 30, 1967). Basic data were collected for urban hydrology studies to determine, on the basis of historical data and hydrologic analyses, the magnitude, frequency, and areal extent of flooding, to document and define floods of greater than ordinary magnitude, and to determine the effect of urban development on flood peaks and volume on small streams in Dallas, Texas. (Knapp-USGS)
W70-05500

COMPILATION OF HYDROLOGIC DATA, MUKEWATER CREEK, COLORADO RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 87 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Mukewater Creek (Tex), Colorado River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 70.0-square-mile area above the stream-gaging station on Mukewater Creek at Trickham, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary to make reliable estimates of total storm inflow to the structures, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05501

COMPILATION OF HYDROLOGIC DATA, PIN OAK CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 25 p, 2 fig, 5 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Pin Oak Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 17.6-square-mile area above the stream-gaging station in Pin Oak Creek near Hubbard, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary to make reliable estimates of total storm inflow to the structures, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05502

COMPILATION OF HYDROLOGIC DATA, NORTH CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 27 p, 2 fig, 2 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: North Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 21.6-square-mile area above the stream-gaging station North Creek near Jackson, Texas. The location of proposed floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall, to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures, to check the applicability of flood-routing procedures and techniques for small watersheds, and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05503

COMPILATION OF HYDROLOGIC DATA, GREEN CREEK, BRAZOS RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 34 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Green Creek (Tex), Brazos River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 46.1-square-mile area above the stream-gaging station Green Creek near Alexander, Texas. The locations of floodwater-retarding structures and hydrologic instruments in the area are shown on a map. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow at downstream points, to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall on small watersheds, and to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures. (Knapp-USGS)
W70-05504

COMPILATION OF HYDROLOGIC DATA, HONEY CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 68 p, 2 fig, 3 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Honey Creek (Tex), Trinity River basin (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 39.0-square-mile area above the stream-gaging station Honey Creek near McKinney, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on maps. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow, to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures, to develop computation techniques that will provide more accurate estimates of runoff, to develop relationships between maximum rates of runoff and rainfall to enable more accurate design of small storm-drainage structures, to determine the minimum instrumentation necessary and to determine the quality of the water, its suitability for use, and its flocculating characteristics as they affect the sediment-trap efficiency of the pools. (Knapp-USGS)
W70-05505

BASE-FLOW-RECESSION CURVES,
C. Toebes, W. B. Morrissey, R. Shorter, and M. Hendy.
New Zealand Handbook of Hydrological Procedures, Procedure No 8, Ministry of Works, Wellington, 1969. 8 p, 8 fig, 4 ref.

Descriptors: *Base flow, *Recession curves, Analytical techniques, Hydrographs, Streamflow forecasting, Hydrogeology, Runoff, Groundwater movement, Low flow, Surface-groundwater relationships, Hydrograph analysis.
Identifiers: Base-flow recession curves.

The uses and interpretation of base-flow recession curves in forecasting streamflow are briefly discussed. The base-flow recession curve is the lower part of the falling limb of a hydrograph and expresses the relation between base flow and time. Since base flow is largely groundwater effluent, the base-flow recession curve represents mainly withdrawal from groundwater storage. However--depending on the water-table level, the river-bank material, the soils in the neighborhood of the river bank, and the rates of rise and fall of the stream--withdrawal from bank storage will contribute to base flow. Several curves have been suggested as representing base-flow recession. The most important of these are: simple exponential, double exponential, and hyperbolic. In conditions where ice melt contributes to the base flow, the ice-melt exponential and the ice-melt hyperbola can be used. (Knapp-USGS)
W70-05507

FLOODS IN MARENGO SOUTH QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
Howard E. Allen.
Geological Survey Open-file report, October 1969. 9 p, 15 fig, 1 plate, 1 ref.

Descriptors: *Floods, *Illinois, Profiles, Maps, Data collections, Hydrologic data, Stage-discharge relations, Frequency analysis, Discharge (Water).
Identifiers: Marengo (Ill).

Hydrologic data are presented to be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Marengo South quadrangle, northeastern Illinois. The areas inundated by floods are delineated on a topographic map. Local residents reported that the flood of August 1968 was the highest observed in the last 20 years. The general procedure used in defining the flood boundaries was to construct flood profiles from elevations of floodmarks identified in the field and from data available from other agencies. There are several depressions and lowland areas where surface water accumulates because of inadequate drainage into the streams. Frequency and depth of flooding in these areas are unrelated to the water-surface elevation along the streams. (Knapp-USGS)
W70-05510

COMPILATION OF HYDROLOGIC DATA, MOUNTAIN CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 9 p, 1 fig, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collection, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: Mountain Creek (Tex), Trinity River basin (Tex).

Collection of hydrologic data by the U.S. Geological Survey in the Mountain Creek watershed, Texas began March 9, 1925, with the establishment of a stream-gaging station about 2-1/2 miles upstream from the present site of Mountain Creek Lake Dam. The stream-gaging station was discontinued July 5, 1933. The purpose of this report is to compile under one cover the basic data collected annually in the Mountain Creek watershed. This report covers the 1967 water year. More than 90% of the watershed is in farms and about 6 percent is in urban areas. The topography ranges from steep rock covered hills along the east edge of the watershed to gently rolling hills in the central and western parts. Elevations range from 870 feet in the Cedar Hill area to about 415 feet in the bottoms near Grand Prairie. The long-term mean annual rainfall for the watershed is about 34 inches. Individual rains may cause serious flooding in any season, but occur most frequently in the spring. (Knapp-USGS)
W70-05511

DIFFUSION BELOW SUBMERGED RECTANGULAR OUTLETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05512

FLOW PHENOMENA NEAR ROUGH BOUNDARIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-05517

FLOOD PLAIN INFORMATION, JORDAN RIVER COMPLEX, SALT LAKE CITY, UTAH.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-05518

FLOOD PLAIN INFORMATION, POESTA CREEK AND SALT CREEK, BEEVILLE, TEXAS.
Corps of Engineers, Galveston, Tex.
For primary bibliographic entry see Field 04A.
W70-05519

FLOOD CONTROL CHANNEL HYDRAULICS,
Corps of Engineers, Los Angeles, Calif. Hydraulics Section.
For primary bibliographic entry see Field 08B.
W70-05523

A THEORY OF STABILITY OF STREAMS,
Nagoya Univ. (Japan). Dept. of Civil Engineering.
Shohei Adachi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A42, p 338-344, 1967. 7 p, 2 fig.

Descriptors: *Alluvial channels, *Meanders, *Mathematical models, Channel morphology, Roughness (Hydraulic), Fluid friction, Turbulent flow, Steady flow, Unsteady flow.
Identifiers: Channel stability.

Stability of streams is treated theoretically by using the small amplitude oscillation theorem to find flow factors contributing to the origin of meandering. In

order to express the lateral variations of stream, flow depth parameters are introduced into the basic equations. By assuming that any disturbance may be superposed on the stationary flow, the stability equation for the lateral variations is formulated. Although the complete solution has not been found, the conditions of the neutral disturbance have been obtained. (Knapp-USGS)
W70-05524

THE BED FORM ON RECTILINEAR AND CURVILINEAR RIVER AND BIG CHANNEL SECTIONS,
Yu. A. Ibad-Zade, and T. N. Kiyasbeili.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A43, p 345-353, 1967. 9 p, 7 fig, 6 ref.

Descriptors: *Channel morphology, *Alluvial channels, Mathematical models, Channel erosion, Open channel flow, Sediment transport, Shape, Meanders.
Identifiers: River bed form.

Continuous interaction between fluid and solid media and natural deformation processes of river beds determine the origin and development of the characteristic bed forms. To use natural processes to form channels, channel deformation processes must be understood. Analytical research with the application of classic methods of the calculus of variations permit calculation of the hydraulic flow elements and the discharge of water passing over beds of given form. Comparison with natural data shows reasonable results. (Knapp-USGS)
W70-05525

ON A SOLUTION OF BED FLUCTUATION IN OPEN CHANNEL WITH MOVABLE BED OF STEEP SLOPE,
Kobe Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-05526

ON THE VELOCITY COEFFICIENT AND HYDRAULIC ROUGHNESS IN MEANDERING WATERCOURSES,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydromechanics.
Oliver Gyorke.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A40, p 324-329, 1967. 6 p, 3 fig, 1 ref.

Descriptors: *Hydraulics, *Alluvial channels, *Roughness (Hydraulic), Sediment transport, Particle size, Particle shape, Mannings equation, Chezy equation, Streamflow, Turbulent flow, Open channel flow, Meanders.
Identifiers: Meandering channels.

Changes in Chezy's velocity coefficient and absolute roughness in a meandering stream were determined on the basis of stages pertaining to several known rates of flow in several typical cross sections in the apex of the bend, at the point of counterflexure and along an approximately straight reach. Differences were found to exist between the values derived from these observation data and those calculated with the characteristic particle diameter of bed material, using the modified Manning-Strickler equation. In this connection the influence of currents in bends on hydraulic roughness is demonstrated. (Knapp-USGS)
W70-05527

THE KINETIC ENERGY CORRECTION FACTOR AND THE MOMENTUM CORRECTION FACTOR IN OPEN CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05528

CALCULATION PROCESS OF POLYGONAL CROSS-SECTION CANALS (FRENCH),
Youlouse Univ. (France). Institut de Mecanique des Fluides.
For primary bibliographic entry see Field 08B.
W70-05529

A RECONSIDERATION OF THE HYDRAULIC RADIUS AS A GEOMETRIC QUANTITY IN OPEN CHANNEL HYDRAULICS,
Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 08B.
W70-05530

THE GRADUALLY VARIED FLOW IN NON-PRISMATIC CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
For primary bibliographic entry see Field 08B.
W70-05531

EXPERIMENTS FOR THE VERIFICATION OF THE PASSAGE THEORY,
Research Inst. for Water Resources Development, Budapest (Hungary).
Zoltan Szigyarto.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A31, p 249-256, 1967. 8 p, 1 fig, 2 ref.

Descriptors: *Hydrograph analysis, *Streamflow forecasting, *Discharge (Water), Gaging stations, Infiltration, Surface-groundwater relationships, Routing.
Identifiers: Hungary.

In many practical hydraulics problems encountered it is necessary to calculate the hydrograph of a downstream section from the known hydrograph of an upstream section and hydraulic properties of the intermediate channel. For the fast and reliable solution of this problem the passage theory was developed. Detailed experiments performed during 1965 for the verification of this theory are described. The theory remains suitable for the reliable transformation of discharge hydrographs even if, in contrast with the fundamental assumption made during the derivation of the theory, the bed is pervious. (Knapp-USGS)
W70-05532

HYDRAULIC SOLUTION AND DEFINITION OF THE UNSTABILITY CRITERION OF STREAM WANDERING WITHIN BED, AND VORTEX ZONES,
Kharkov Vodokanalniiproekt Inst. (USSR). Hydraulic Engineering Lab.
I. A. Sherenkov.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A30, p 240-248, 1967. 9 p, 4 fig, 10 ref.

Descriptors: *Meanders, *Alluvial channels, *Channel morphology, *Bank stability, Bank stabilization, Turbulent flow, Erosion, Scour, Bed load, Discharge (Water), Sediment discharge, Stream stabilization.
Identifiers: USSR, Stream channel stability.

A new method of calculation of a flow expanding within its bed with the creation of lateral vortexes is described. The flow is divided into a direct flow, to which a transitory stream and a forward flow of vortex are included, and a zone of reversal flow, which is the return branch of the vortex flow. The interaction between these areas is manifested by changes of the rate of discharge along the way, as well as creation of shear stresses on the boundary of the zones. From the equation of momentum and the changes of the discharge rate along the stream, and the equation of continuity, a system of equations for calculation is obtained. To solve the problem of the wandering stream stability, the Liapunov's direct method has been applied, and criterion of stability was obtained. The method of calculation is applicable for computers. (Knapp-USGS)
W70-05533

EFFECTS OF STAGES ON SCOUR ALONG RIVERBANKS,
US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Hydraulics Div.
John J. Franco.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A29, p 232-239, 1967. 8 p, 3 fig.

Descriptors: *Stage-discharge relations, *Scour, *Erosion, *Mississippi River, Hydraulics, Sediment transport, Bed load, Discharge (Water), Streamflow, River training, Flood protection, Bank stability, Bank stabilization, Stream stabilization.
Identifiers: *Stage-scour relations.

Periodic surveys were made along several reaches of the Mississippi River through one high-water season to determine the effects of changes in river stages on depth of scour along concave riverbanks. The results have shown that scour or deposition can occur along riverbanks depending on the alignment and configuration of the channel upstream and downstream and river stages. In general, the depth of scour increases with increase in river stage but the alignment of the channel can be such that deposition occurs with rising stages. Also, the location of the point of maximum scour or deposition can change with change in stage. These results indicate how regulating and stabilizing structures can be affected by the change in stage. In rivers where the rate of change of stages is moderate, the depth of scour or deposition is more a function of the actual stage (elevation) and stage duration than of the rate of change. (Knapp-USGS)
W70-05534

THE SIMILARITY IN FLOWS AT STRAIGHT REACHES OF RIVERS,
Leningrad Inst. of Water Transport (USSR).
K. V. Grishanin.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A28, p 226-231, 1967. 6 p, 2 fig, 2 tab, 2 ref.

Descriptors: *Stage-discharge relations, *Alluvial channels, *Rivers, Hydraulics, Open channel flow, Streamflow, Streamflow forecasting, Equations, Hydraulic similitude.
Identifiers: *USSR, *Rating curves.

A hypothesis is proposed concerning the relation between the geometric similarity of river channels and dynamic similarity of river flows. Measurements made at the rivers in the plains of the USSR confirm the hypothesis well. As a result of considerations, a universal rating curve, approximately valid for river straight reaches of arbitrary width and depth is plotted. By the aid of this curve it is possible to determine the rough value of a water discharge in the absence of information about the channel resistance and the water surface slope. (Knapp-USGS)
W70-05535

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
For primary bibliographic entry see Field 07B.
W70-05543

2F. Groundwater

RECONNAISSANCE OF THE GROUNDWATER RESOURCES OF THE UPPER FREMONT RIVER VALLEY, WAYNE COUNTY, UTAH,
Geological Survey, Logan, Utah.
L. J. Bjorklund.
Copies of report available at Utah Dept of Natural Resources, Div of Water Rights, 442 State Capitol, Salt Lake City, Utah. Technical Publication No 22, 1969. 54 p, 11 fig, 6 tab, 21 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Aquifers, Water wells, Artesian wells, Water supply, Water quality, Data collections, Hydrologic data, Hydrogeology, Alluvium, Springs, Water yield.
Identifiers: Fremont River valley (Utah).

The upper Fremont River valley, a depression caused by faulting, altered by erosion, and partly filled by alluvium eroded from surrounding highlands, includes about 40 square miles in south-central Utah. The drainage basin which contributes water to the valley includes about 700 square miles. Water drains to the valley from several high plateaus. Sedimentary rocks of Triassic, Jurassic, Tertiary, and Quaternary age and volcanic rocks of Tertiary age are exposed in the area. The Tertiary volcanic rocks yield water to several large springs and flowing wells; this unit is the principal source of groundwater in the valley. The valley fill of Quaternary age, which is more than 500 feet thick in places, is also an important source, yielding water to many wells. The average annual inflow to the valley via the Fremont River during 1950-57 was 29,120 acre-feet and the average annual outflow during 1909-57 was 64,840 acre-feet. About 80,000 acre-feet of water is discharged by springs and seeps in the valley during most years. Approximately 3,500 acre-feet of water is discharged from flowing wells and about 700 acre-feet is pumped from wells during a year. Irrigation is the principal use of both surface and groundwater in the valley. Groundwater is used also for the public supplies of Fremont, Loa, Lyman, and Bicknell, for domestic and stock use, and for fish culture. The groundwater in the valley is suitable for most uses. (Knapp-USGS)
W70-05071

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER -- PHASE I,
Kansas Water Resources Research Inst., Manhattan.
Don W. Green, and Ronald L. Cox.
Available from the Clearinghouse as PB-190 481, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Kansas Water, Water Resources Institute Contribution No. 3, (September, 1966). 107 p, 28 ref, 4 append. OWRR Project B-003-KAN.

Descriptors: *Digital computers, *Mathematical models, *Underground reservoirs, *Saline waters, *Fresh water, Underground storage, Aquifers, Recharge, Porous media, Permeability, Flow.

A computer model has been developed for application to salt water - fresh water displacement processes in porous media. It is based on the numerical method of characteristics as presented by Garder, Peaceman, and Pozzi. The model is two-dimensional, allows for dispersion of mixing of the fluid-fluid interface, and accounts for fluid density differences. Porous-media properties are held constant. The details of the computer program including a listing are included in this report. Several calculations were made with the model approximating laboratory-scale displacement experiments and an actual field underground fresh-water storage test. These calculations indicate the potential usefulness of the mathematical model.
W70-05116

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER-PHASE II,
Kansas Water Resources Research Inst., Manhattan.
Don W. Green, Ronald Cox, and Craig Bate.
Available from the Clearinghouse as PB-190 482, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Kansas Water Resources Research Institute Contribution Number 36, 1970. 187 p, 16 tab, 45 fig, 43 ref, 2 append. OWRR Project B-008-KAN.

Descriptors: *Digital computers, *Mathematical models, *Underground reservoirs, *Saline water, *Fresh water, Underground storage, Aquifers, Recharge, Porous media, Permeability, Flow.

A digital computer model has been developed to solve numerically the partial differential equations describing liquid-liquid miscible displacement in two-space dimensions in porous media. The model is based on the method of characteristics solution previously described in the literature. The model presented here was first described in a project completion report covering Phase I of this work. A laboratory experimental system that is a physical analog of the mathematical model was designed and constructed. Experimental miscible displacements were conducted in which water of one salt concentration displaced water of a different salt concentration. Concentrations were measured insitu in the porous media as a function of time and position by using conductivity cells wired to a multi-point recorder. Concentration differences between the two solutions were varied in different runs in order to alter the amount of gravity segregation. Other experiments were conducted in which the porous-media system was composed of two layers of different size glass beads and, therefore, different permeabilities. The experimental displacements were simulated with the computer model. The model, in general, did a good job of predicting the behavior of the liquid-liquid interfacial concentration zone.
W70-05117

EFFECTS OF BANK SEEPAGE ON FLOOD HYDROGRAPHS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02A.
W70-05126

BORON IN GROUNDWATERS OF THE CRETACEOUS OF THE WEST CAUCASUS FORELAND,
Voronezh State Univ. (USSR).
For primary bibliographic entry see Field 02K.
W70-05137

NONSTEADY FLOW TO SURFACE RESERVOIR,
California Univ., Los Angeles. School of Engineering and Applied Science.
W. Wen-Gong Yeh.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7137, pp 609-618, March 1970. 10 p, 6 fig, 2 tab, 16 ref, append.

Descriptors: *Bank storage, *Unsteady flow, *Groundwater movement, *Aquifers, *Mathematical studies, Drawdown, Mathematical models, Computers, Equations, Dimensional analysis, Base flow, Water table, Water level fluctuations, Surface-groundwater relationships, Water yield.
Identifiers: Bank storage yield.

When groundwater flows from an unconfined aquifer to a surface reservoir the position of the water table will change with time. The nonlinear partial differential equation for water table elevation is transformed to a nonlinear ordinary differential equation by similarity substitution and a numerical procedure for its solution is presented. A method of computing bank storage is presented. The solution compares favorably with the experimental results obtained by others. (Knapp-USGS)
W70-05158

EXACT FLOW RATES FROM DUPUIT'S APPROXIMATION,
Washington Univ., Seattle. Dept. of Civil Engineering.
Bruce W. Hunt.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7140, p 633-642, March 1970. 10 p, 5 fig, 7 ref, append.

Descriptors: *Groundwater movement, *Dupuit-Forchheimer theory, Seepage, Aquifers, Water table, Water level fluctuations, Equations, Permeability, Porous media.
Identifiers: Aquifer leakage.

Certain problems in three-dimensional, confined and unconfined, groundwater seepage are reduced to two-dimensional boundary-value problems by integrating the exact equations of motion in the vertical direction. It is shown that the solution of these two-dimensional boundary-value problems gives exact flow rates, and that these flow rates are identical to those obtained from the classical Dupuit theory of groundwater motion. It is also concluded that free surface coordinates and piezometric head distributions are not, in general, given exactly by the Dupuit formulation. (Knapp-USGS)
W70-05162

TECHNIQUES FOR THE TRACING OF SUBTERRANEAN DRAINAGE,
David P. Drew, and David I. Smith.
British Geomorphological Research Group Technical Bulletin No 2, 1969. 36 p, 5 fig, 2 tab, 45 ref.

Descriptors: *Tracers, *Tracking techniques, *Subsurface drainage, *Groundwater movement, *Karst, Radioactivity techniques, Spores, Clubmoss, Dye releases, Drainage systems, Drainage patterns (Geologic), Geomorphology.
Identifiers: Underground drainage tracing.

Methods for tracing groundwater movement, particularly in karst systems, are discussed. An annotated bibliography is included. The choice of tracing method will depend on a large number of factors. Major factors are expense on both capital equipment and the tracer itself, the time available, and the problem of toxicity. For tests of streams of small discharge over relatively short distances the dye methods are often suitable. Their major handicap for detailed studies is that if the dilution is large it may be beyond the limits of detection. For reconnaissance studies particularly in regions remote from laboratory facilities rhodamine B or malachite green are preferable to fluorescein as, under field conditions, fluorescein can often become rapidly bleached. For detailed work yielding additional information on flow times the Lycopodium spore method is the best tracer available. For the tracing of percolation water the only simple method is that employing pyranine concentrate. The alternative of using radioactive tracers is expensive and usually prohibited by authorities controlling water supplies. (Knapp-USGS)
W70-05166

WATER RESOURCES OF THE YELLOW MEDICINE RIVER WATERSHED, SOUTHWESTERN MINNESOTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-05168

AVAILABILITY OF GROUNDWATER FOR LARGE-SCALE USE IN THE MALAD VALLEY-BEAR RIVER AREAS OF SOUTHEASTERN IDAHO--AN INITIAL ASSESSMENT,
Geological Survey, Boise, Idaho. Water Resources Div.
W. L. Burnham, A. H. Harder, and N. P. Dion.

Geological Survey Open-file Report, 1969. 40 p, 7 fig, 2 tab, 5 ref.

Descriptors: *Water resources, *Idaho, *Groundwater, Aquifers, Water yield, Water resources development, Irrigation water, Water wells, Alluvium, Water supply, Water levels, Artesian wells.
Identifiers: Malad Valley (Idaho), Bear River (Idaho).

Parts of the Bear River drainage of southeastern Idaho offer potential for further development of groundwater -- the valley north of Bear Lake, north of Soda Springs, Gem Valley, Cache Valley in Idaho, and Malad Valley in Idaho. Malad Valley contains a large aquifer system in valley fill underlying about 75 square miles. The aquifer system is several hundred feet thick, and contains about 1.8 million acre-feet of water in storage in the top 300 feet of saturated thickness. Average annual recharge to the valley-fill aquifer is about 64,000 acre-feet. Lowering of the water level 100 feet uniformly over the valley area would theoretically yield about 300,000 acre-feet from storage and salvage a present-day large nonbeneficial discharge. Chemical-quality problems in Malad Valley seem not to be sufficient to prohibit development and use of the groundwater resource. (Knapp-USGS)
W70-05169

SUBSURFACE DISPOSAL OF INDUSTRIAL WASTES,
Michigan State Geological Survey, Lansing.
For primary bibliographic entry see Field 05E.
W70-05181

DATA FOR SPRINGS IN THE NORTHERN COAST RANGES AND KLAMATH MOUNTAINS OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
C. F. Berkstresser, Jr.
Geological Survey Open-file report, 1968. 49 p, 1 fig, 159 ref, 2 append.

Descriptors: *Springs, *California, Groundwater, Hydrogeology, Hydrologic data, Data collections, Aquifers, Water quality, Water chemistry, Water yield, Water supply.
Identifiers: Klamath Mountains (Calif), Coast Ranges (Calif).

Basic data are provided about selected springs in the Coast Ranges and Klamath Mountains north of San Francisco, California. Criteria used to select springs included accessibility, availability of previous data, and geologic or hydrologic significance. Temperature and pH were measured at the spring site and ammonium was determined qualitatively. Flow was measured or estimated, depending on the situation at each site. The location of each site was determined on topographic or other available maps. Chemical and spectrographic analyses include most of the major, minor, and trace inorganic constituents that occur in natural water. The bibliography includes references to springs, groundwater flow, geochemistry, hydrothermal waters, California groundwater resources, California geology, California mineral waters, California mineral resources, and water chemistry. (Knapp-USGS)
W70-05182

GROUNDWATER FLOW SYSTEMS AND RELATED HIGHWAY PAVEMENT FAILURE IN COLD MOUNTAIN VALLEYS,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 04C.
W70-05184

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 4,
Geological Survey, Raleigh, N.C.
Orville B. Lloyd, Jr., and Hugh B. Wilder.
North Carolina Department of Water Resources Report of Investigations No 5, 1968. 19 p, 5 fig, 3 tab, 3 ref.

Descriptors: *Water supply, *Groundwater, *National seashores, *North Carolina, Aquifers, Geology, Sands, Water wells, Water yield, Water quality, Hydrologic data.
Identifiers: Cape Hatteras National Seashore.

In the spring of 1963, the Park Service requested the U.S. Geological Survey to determine whether or not adequate groundwater could be obtained in the vicinity of Fort Raleigh National Historical Site, Cape Hatteras, to supply park headquarters, other administrative buildings, and ranger homes. In general, the rock material that underlies the area of study consists largely of sand that was deposited in a marine environment. Four units of sand, silt, and clay underlie the Fort Raleigh area to depths of about 157 ft below land surface. The moderately coarse sand unit between approximately 18 and 44 ft below land surface is the best aquifer in which to develop future groundwater supplies in the area. Two-inch diameter wells spaced no less than 180 ft apart and tapping the full thickness of the aquifer between approximately 18 and 44 ft will yield 20 gpm each. Future well fields should be located as far from the sounds as possible to decrease the possibility of lateral salt-water encroachment. Water from wells in the area will require treatment to remove hardness-causing constituents and dissolved iron. (Knapp-USGS)
W70-05185

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 5,
Geological Survey, Raleigh, N.C.
Granville B. Wyrick, and Roberta B. Dean.
North Carolina Department of Water Resources Report of Investigations No 6, 1968. 29 p, 14 fig, 1 tab, 6 ref.

Descriptors: *Water supply, *Groundwater, *National seashores, *North Carolina, Aquifers, Geology, Sands, Water wells, Water yield, Water quality, Hydrologic data.
Identifiers: Cape Hatteras National Seashore.

The National Park Service requested, in 1965, that the U.S. Geological Survey assist in the design of, and conduct the testing of a lateral well near Try Yard Creek, Ocracoke Island, Cape Hatteras National Seashore Recreational Area, North Carolina. The lateral well method of construction is a practical solution for recovering fresh groundwater in beach areas closely underlain by salt water. The pumping rate should not exceed 20 gpm in order to prevent drawing the water levels down to the well screens. Pumping at 20 gpm should be intermittent to allow sufficient time for natural groundwater flow to flush the upward movement of salt water away from the well. A pumping period of 8 hr in each 24 hr should furnish about 10,000 gpd for the campground without inducing salt water encroachment to the well. The water should be treated for iron, manganese, and hydrogen sulfide, which were the only chemical constituents present in concentrations that would contribute undesirable characteristics to the water. Treatment recommended for the development of a water supply for drinking purposes should include aeration, filtration, and chlorination. (Knapp-USGS)
W70-05186

MODELLING PARTIALLY PENETRATING RIVERS ON AQUIFER MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05478

NONINSTRUMENTAL FACTORS AFFECTING MEASUREMENT OF STATIC WATER LEVELS IN DEEPLY BURIED AQUIFERS AND AQUITARDS, NEVADA TEST SITE,
Geological Survey, Las Vegas, Nev.
For primary bibliographic entry see Field 07B.
W70-05479

ELECTRIC WELL LOGGING OF HAWAIIAN BASALTIC AQUIFERS,
Hawaii Univ., Honolulu. Dept. of Geosciences; and Honolulu Board of Water Supply, Hawaii.
For primary bibliographic entry see Field 07B.
W70-05480

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02A.
W70-05481

REGIONAL GROUNDWATER FLOW-OLD WIVES LAKE DRAINAGE BASIN, SASKATCHEWAN,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
R. A. Freeze.
Inland Waters Branch Scientific Series No 5, Canada, Department of Energy, Mines and Resources, 1969. 245 p, 52 fig, 4 plate, 12 tab, 93 ref, 5 append.

Descriptors: *Groundwater movement, *Mathematical models, *Groundwater basins, Digital computers, Computer models, Groundwater discharge, Precipitation (Atmospheric), Runoff, Rainfall-runoff relationships.
Identifiers: Old Wives Lake (Saskatchewan).

The regional groundwater flow system of Old Wives Lake drainage basin, Saskatchewan was studied using field techniques including piezometric analyses, hydrogeochemistry, surficial mapping and low-flow methods. The results were interpreted with the aid of a theoretical approach involving digital computer solutions to mathematical models of groundwater basins. The areas in which two- and three-dimensional mathematical models provided good correlation with the field evidence include a prairie profile environment, a flowing artesian region, a buried valley, a phreatophytic discharge area, and a system of deep 'confined' aquifers. In the Old Wives Lake drainage basin, precipitation varies from 12 to 16 inches per year, potential evapotranspiration from 21 to 24 inches per year, and total runoff from 0.54 to 0.68 inch per year. The average regional groundwater recharge calculated from baseflow interpretation and from moisture budget determinations is in the range 0.10 - 0.20 inch per year. Areally dependent values of groundwater recharge determined from mathematical model results vary from 0.0 to 0.4 inch per year in glacial till to as high as 7.0 inches per year in sand. (Knapp-USGS)
W70-05485

MINERAL AND THERMAL WATERS OF THE WORLD, A-EUROPE.

Georgij Kacura, Editor. Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, 1969. 177 p.

Descriptors: *Thermal water, *Mineral water, Geology, Structural geology, Hydrologic data, Heat flow, Water chemistry, Thermal properties, Trace elements, Water resources, Legal aspects, Mapping, Springs.
Identifiers: Mineral and thermal water seminar.

In January 1966 the 23rd International Geological Congress held a seminar on the 'Genesis of Thermal and Mineral Waters.' Geological conditions, chemical composition of mineral waters, terrestrial

heat flow data, possibilities of the utilization of waters for medical purposes, energy sources, rare elements, and legal protection of water resources were discussed. (See also W70-05488 thru W70-05499). (Gabriel-USGS)
W70-05487

MINERAL AND THERMAL WATERS OF BELGIUM (FRENCH),
J. M. Graulich.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 9-15, 1969. 7 p, 1 fig, 1 tab, 7 ref.

Descriptors: *Mineral water, *Thermal water, *Water chemistry, Aquifers, Groundwater, Salinity, Carbon dioxide, Surface waters, Water temperature, Mapping, Discharge (Water), Carbonates, Springs.
Identifiers: *Belgium.

In general, thermal and mineral water resources of Belgium are rather poor. One of a few natural thermal flows in Chaudfountaine (36 deg), however a few other thermal flows, such as Baudour (53 deg), are located at considerable depths. Mineral waters are mainly of iron and carbonate types containing an abundance of free carbon dioxide such as Spa and Chevron. Water containing more than 1 gram per liter is present at considerable depths in the Gand and Ostende areas. (See W70-05487). (Gabriel-USGS)
W70-05488

THERMAL AND MINERAL WATERS OF CZECHOSLOVAKIA,
G. Kacura, S. Gazda, O. Franko, and J. Silar.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 17-29, 1969. 13 p, 1 fig, 2 tab, 16 ref.

Descriptors: *Thermal water, *Mineral water, *Water chemistry, *Aquifers, *Groundwater, *Springs, Geology, Structural geology, Salinity, Carbon dioxide, Sulfates, Mapping, Water temperature, Chlorides, Carbonates, Heat flow, Boreholes.
Identifiers: *Czechoslovakia.

The Czechoslovak territory abounds in thermal and mineral springs of various types, as a result of diversity of geological conditions. Until present more than 1600 sites of thermal and mineral springs have been recognized with many springs characterized by their high Na, Cl, Fe, bicarbonate, carbon dioxide, Hydrogen sulfide and Mg contents. The most significant mineral waters are utilized for therapeutic purposes. At present there are 37 spas in Czechoslovakia and twenty-five springs are utilized for commercial bottling purposes. (See W70-05487). (Gabriel-USGS)
W70-05489

MINERAL WATERS OF THE GERMAN DEMOCRATIC REPUBLIC (GERMAN),
J. Zieschang.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 59-68, 1969. 10 p, 1 fig.

Descriptors: *Mineral water, *Aquifers, *Water chemistry, *Groundwater, *Springs, Geology, Mapping, Geographical regions, Sulfates, Carbon dioxide, Carbonates, Discharge (Water), Thermal water.
Identifiers: *German Democratic Republic.

The German Democratic Republic has a large number of mineral surface water localities and 3/4 of its territory contains highly mineralized waters at considerable depths; however, the Republic is rather poor in thermal water occurrences. Mineral waters are mainly of sodium-chloride type, but sulfate, carbon dioxide, and bicarbonate waters are also present. The territory of the Republic is subdivided into 6 mineral water provinces whose mineral-water characteristics and geology are described. (See W70-05487). (Gabriel-USGS)
W70-05490

THERMAL, MINERAL, AND THERAPEUTIC WATERS OF HUNGARY (GERMAN),
E. R. Schmidt.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 69-76, 1969. 8 p, 1 fig, 5 ref.

Descriptors: *Thermal water, *Mineral water, *Aquifers, *Springs, *Groundwater, Geothermal studies, Water temperature, Boreholes, Discharge (Water), Mapping, Water chemistry, Carbonates, Calcium, Magnesium, Chlorides, Sulfates, Iron, Trace elements, Radioactivity, Geology.
Identifiers: *Hungary.

Geological and hydrological studies of Hungary show the presence of 975 thermal water wells, of discharges varying from 200 to 2000 l/min. There are numerous occurrences of mineral waters of Na-bicarbonate Ca-Mg, NaCl, Sulfate, Al-Fe, Sulfide, and I-Br types. Some mineral and therapeutic waters contain radioactive minerals, such as radium and disintegration products of radium, thorium, and actinium. (See W70-05487). (Gabriel-USGS)
W70-05491

GENERAL ASPECTS OF THERMAL ACTIVITY IN ICELAND,
S. Arnorsson, J. Jonsson, and J. Tomasson.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 77-86, 1969. 10 p, 3 fig, 3 tab, 13 ref.

Descriptors: *Thermal water, *Aquifers, *Groundwater, Water temperature, Geology, Igneous rocks, Springs, Boreholes, Discharge (Water), Salinity, Heating, Mapping, Mineral water, Water chemistry.
Identifiers: *Iceland.

Thermal areas in Iceland have been classified into high and low temperature areas. The high temperature areas are confined to the active volcanic belt, frequently associated with acid volcanic rocks. The low temperature areas are mainly situated in the Tertiary flood basalt areas. The total flow from thermal springs and drillholes is estimated at the present as some 2700 l/sec with an average temperature of roughly 120 deg C. With few exceptions the Icelandic thermal waters are low in total dissolved solids in particular those elements not influenced by mineral equilibria with the wall rock. Most of the utilized thermal energy is used for domestic heating purposes. (See W70-05487). (Gabriel-USGS)
W70-05492

ITALIAN THERMAL AND MINERAL SPRINGS,
A. V. Damiani, and A. Moretti.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 87-98, 1969. 12 p, 1 fig, 3 tab, 7 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Geology, Mapping, Water temperature, Water chemistry, Sulfates, Sodium, Potassium, Carbonates, Boreholes, Igneous rocks, Sulfides.
Identifiers: *Italy.

The geological, thermal, and chemical characteristics of mineral hot (over 20 deg C) and cold (less than 20 deg C) springs of Italy are described. The thermal springs are associated with the strong magnetic activity taking place in the Veneto Maremma, Latium, Campania, Sicily, and Sardinia districts. The cold springs are associated with Upper Miocene sediments. Many of the hot springs are characterized by relatively large contents of Cl, sulfate, bicarbonate, Na, Ca and Mg. Lacco Amero and Tivoli hot springs contain relatively high amounts of carbon dioxide and Ra. The cold springs are characterized by their relatively high sulfur, bromine and iodine, radio-activity, or arsenic contents. (See W70-05487). (Gabriel-USGS)
W70-05493

GENERAL REVIEW OF THE MINERAL AND THERMAL WATERS OF ROMANIA (FRENCH),
C. Ghenea, and M. Nicolescu.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 99-112, 1969. 14 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Mineral water, *Thermal water, *Aquifers, *Groundwater, Geology, Mapping, Discharge (Water), Water temperature, Salinity, Sulfides, Carbon dioxide, Carbonates, Calcium, Sodium, Magnesium, Iron, Potassium.
Identifiers: *Romania.

Romania contains several thousands occurrences of mineral and thermal waters associated with various geological provinces. The temperature of thermal and mineral waters varies from less than 20 deg C to about 87 deg C, with mineral waters characterized by mineralization of 1 g/l to 266 g/l. Mineral lakes of the Romanian plain are characterized by mineralization 16.96 g/l (B. almara) to 299.82 (Movila Mirosei). Mineral waters of Romania have relatively high concentrations of bicarbonate, Cl, Na, Ca, Mg, K, some sulfate and some I, Br, carbon dioxide and hydrogen sulfide. Thermal waters are utilized for therapeutic purposes. (See W70-05487). (Gabriel-USGS)
W70-05494

MINERAL AND THERMAL WATERS OF SPAIN (SPANISH),
Juan Manuel Lopez de Azcona.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 113-125, 1969. 13 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Mineral water, *Thermal water, *Groundwater, *Aquifers, *Springs, Mapping, Geology, Structural geology, Discharge (Water), Water temperature, Hydrogeology, Water chemistry, Water utilization.
Identifiers: *Spain.

Hydrogeological, chemical, and geographical characteristics of thermal and mineral waters of Spain are briefly described. An historical review of the effect of earthquakes on water level fluctuations of thermal and mineral springs of Spain is given. (See W70-05487). (Gabriel-USGS)
W70-05495

MINERAL AND THERMAL WATERS OF SWEDEN,
P. Engqvist.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 127-131, 1969. 5 p, 1 fig, 1 tab.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Boreholes, Salinity, Geology, Water chemistry, Calcium, Magnesium, Chlorides, Sulfates, Discharge (Water), Sodium, Mapping, Water temperature.

Identifiers: *Sweden.

Chemical analysis are given for water from 43 boreholes passing through mineral water-bearing horizons of Quaternary, Triassic, Cretaceous, Silurian, Ordovician, and Archean age at depths of 4 to 1,855 meters in Sweden. The waters are mainly of chloride type with relatively small contents of sulfate, bicarbonate, Na, Ca, and Mg. The occurrence of thermal water in Sweden is not completely known. (See W70-05487). (Gabriel-USGS)
W70-05496

MINERAL SPRINGS OF SWITZERLAND (GERMAN),
J. Cadisch.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress. 1968, Academia Prague, p 133-137, 1969. 5 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Mineral water, *Springs, *Groundwater, *Thermal water, Water temperature, Mapping, Aquifers, Salinity, Discharge (Water), Radioactivity, Water chemistry, Carbon dioxide, Iron, Sulfides, Strontium radioisotopes, Fluorine, Arsenic compounds.
Identifiers: *Switzerland.

A map of the distribution of mineral and thermal springs in Switzerland is presented. Chemical character, radioactivity, temperature, discharge, and free carbon dioxide content of 39 mineral spring occurrences are given. Many springs utilized for therapeutic purposes are characterized by the presence of Li, Fe, Sr, Br, I, F, B, and S. (See W70-05487). (Gabriel-USGS)
W70-05497

MINERAL AND THERMAL WATERS OF THE UNITED KINGDOM,
W. M. Edmunds, B. J. Taylor, and R. A. Downing.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 139-158, 1969. 20 p, 5 fig, 4 tab, 16 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Groundwater, *Aquifers, Geology, Water chemistry, Mapping, Water utilization, Salts, Brines, Iron, Calcium, Magnesium, Sodium, Potassium, Sulfates, Carbonates, Trace elements, Discharge (Water).
Identifiers: *United Kingdom.

The mineral waters of the United Kingdom are classified according to their chemical characteristics and related geological environments. A map shows the distribution of mineral and thermal waters. A brief survey is made of the current usage of mineral waters, with particular attention to brine extraction. The mineral waters are found in several geological horizons from Eocene to Ordovician age, and can be subdivided into the four types as follows: (Ca, Mg) sulfate, (Ca, Mg) Cl, (Na+K) Cl, and (Na+K) sulfate. Li, Sr, Ba, I, Br, phosphate, Mn, Ni, and Fe are the minor constituents of these waters. (See W70-05487). (Gabriel-USGS)
W70-05498

THERMAL, MINERAL, AND INDUSTRIAL WATERS OF THE SOVIET UNION,
F. A. Makarenko, I. K. Zaitzev, V. V. Ivanov, and V. F. Mavritzky.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, A-Europe, Vol 18, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 159-177, 1969. 19 p, 3 fig, 20 ref.

Descriptors: *Thermal water, *Mineral water, *Industrial water, *Aquifers, *Groundwater, Geology, Geological structures, Hydrogeology, Artesian wells, Mapping, Water temperature, Discharge (Water), Radioactivity, Water chemistry, Sulfides, Carbon dioxide, Trace elements.

Identifiers: *USSR.

General information, expressed in diagramatic maps is given on the mineral thermal, and industrial waters of the Soviet Union. The maps show the fundamental regularities in the development of the USSR underground mineral and thermal waters indicating the presence of 5 hydrochemical provinces as follows: thermal waters in areas of latest volcanism; carbon dioxide waters in areas of young magmatic activities (Quaternary and Neogene); nitrogen-bearing thermal waters in areas of young tectonic faults; nitrogen, nitrogen-methane, and methane waters of artesian basins; and oxygen-nitrogen radon waters of acid crystalline rocks. The mineral balneological waters of the union consist of the following types: waters without specific components or properties; carbon dioxide; sulfide waters; arsenic waters with high content of Mn, Cu, Al, Radon (radioactive) waters; and siliceous thermal waters. Industrial mineralized waters of the Soviet Union are described in some details. (See W70-05487). (Gabriel-USGS)
W70-05499

IRRIGATION AND MUNICIPAL WELLS IN THE SAN LUIS VALLEY, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 04B.
W70-05508

GEOHYDROLOGY AND GROUNDWATER POTENTIAL OF ST. JOSEPH COUNTY, INDIANA,
Geological Survey, Indianapolis, Ind.
J. D. Hunn, and J. S. Rosenshein.
Indiana Division of Water Bulletin No 33, 1969. 20 p, 5 fig, 3 plate, 4 tab, 19 ref.

Descriptors: *Water resources, *Groundwater, *Indiana, *Glacial drift, Aquifers, Sands, Gravels, Hydrogeology, Data collections, Hydrologic data, Surveys, Investigations.
Identifiers: *St. Joseph County (Ind).

The principal sources of groundwater in St. Joseph County, Indiana are unconsolidated rocks of Quaternary age. These rocks form a single but complex hydrologic system that is locally more than 450 feet thick and consists of three units. The groundwater potential of the county is estimated to be 400 mgd of which about 54 mgd is being pumped. Unit 3, a sand and gravel unit, is the principal aquifer of the county. This unit is partly artesian and partly water table. Recharge is estimated to average 200,000 gpd per square mile, or about 40 mgd. Possible yields to individual wells range from about 25 to more than 3,000 gpm. (Knapp-USGS)
W70-05509

2G. Water in Soils

CLOGGING OF POROUS COLUMN OF SPHERES BY SEDIMENT,
California Univ., Berkeley. Coll. of Engineering.
For primary bibliographic entry see Field 02J.
W70-05151

SEEPAGE STUDY USING ELECTRICAL ANALOG,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Technische Universitaet, Berlin (West Germany). Dept. of Water Structure and Water Economy.
Heinz Stefan, and Johannes Meyer.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7064, p 411-416, February 1970. 6 p, 5 fig, 3 ref.

Descriptors: *Analog models, *Seepage, *Porous media, Groundwater movement, Soil water movement, Analog computers, Permeability, Dams, Model studies, Leakage, Reservoir leakage, Reservoir design.
Identifiers: Seepage models.

A simple and inexpensive electrical analog is considered, which was used to study two-dimensional seepage in heterogeneous media. It consists of multiple layers of conductive paper. Simple techniques for the analog assembly are described. The analog technique is applied to a study of flow through two pervious layers of different permeabilities under a structure with a cutoff wall upstream. Results with regard to flow rates, pressure head distributions and exit pressure gradients are presented in dimensionless and graphical form. (Knapp-USGS)
W70-05155

SEASONAL VARIATION OF HYDRAULIC PARAMETERS AND THEIR INFLUENCE UPON SURFACE IRRIGATION APPLICATION EFFICIENCY,
North Dakota State Univ., Fargo; and Rock Island Arsenal, Ill.
For primary bibliographic entry see Field 03F.
W70-05235

SOME LIMITATIONS ON ESTIMATES OF INFILTRATION AS A BASIS FOR PREDICTING WATERSHED RUNOFF,
Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center; and Arizona Agricultural Experiment Station, Tucson.
R. B. Hickok, and H. B. Osborn.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 798-800, 803, November-December 1969. 1 tab, 10 ref.

Descriptors: *Infiltration, *Soil surfaces, *Rainfall-runoff relationships, *Runoff, *Watersheds (Basins), Surface runoff, Subsurface runoff, Mathematical models, Hydrologic cycle, Hydrology, Model studies, Hydrologic data, Semiarid climates, Small watersheds, Rainfall intensity, Depth-area-duration analysis.
Identifiers: Unit-source watersheds, Walnut Gulch Experimental Watershed (Ariz).

The concept of infiltration does not generally provide an adequate model of watershed rainfall-runoff relationships, nor does it satisfactorily yield precise runoff predictions. This is due in part to the fact that mathematical models have not adequately represented such complex influences on infiltration as the interrelations of soil characteristics, microrelief, ground cover, and rainfall characteristics. A second problem with this concept is the invalid assumption that the soil surface divides rainfall into two parts which then pursue distinct courses through the hydrologic cycle. Since this assumption requires a homogeneity of watershed soils and geology which seldom exists naturally, it places limitations of the use of small-plot experimental data. The most useful index to quantify overall operational characteristics of unit-source watersheds may be apparent net infiltration. This could also be used to derive relationships of hydrologic behavior of watersheds to their measurable physical parameters. Such an index cannot be synthesized from small-plot infiltrometers or infiltration measurements from a laboratory. (Carr-Arizona)
W70-05290

EFFECT OF SOIL PROFILES ON MOVEMENT OF WATER ON SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
L. F. Whitney, Kazuki Muta, and E. S. Pira.
American Society of Agricultural Engineers, Transactions, Vol 12, No 1, p 98-99, January-February 1969. 7 fig, 1 tab, 6 ref.

Descriptors: *Subsurface irrigation, *Irrigation systems, *Interfaces, *Soil texture, *Soil profiles, Topsoil, Subsoil, Irrigation design, Soil water movement, Water pressure, Soil moisture.

Research was concerned with the reaction of water movement when water from a pressurized source reached the interface between soils of different textures. The beneficial effects of a layered soil profile

for subsurface irrigation were demonstrated. This is particularly useful in subsurface irrigation of turf areas such as golf courses which are constructed to specifications. In irrigation of crops, however, the pipe network must be placed below tillage level. If the nozzles lie below the interface it is unlikely that irrigation water will reach shallow-rooted crops. If the nozzles are above the interface, i.e., the top 16 inches of soil is homogeneous, then subsurface irrigation can be effectively employed. (Carr-Arizona)
W70-05291

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
California Univ., Davis. Dept. of Water Science and Engineering.
James N. Luthin, and Frank Robinson.
American Society of Agricultural Engineers, Transactions, Vol 12, No 1, p 27-28, 31, January-February 1969. 3 p, 3 fig, 1 tab, 6 ref. Water Resources Center Project No. W125-3U-63/70.

Descriptors: *Drainage, *Salinity, *Capillary action, *Hydraulic conductivity, *Irrigation water, Irrigated land, Soil water movement, Leaching, Saline water, Salts, Stratification, Water table, Crop response, Saline soils, Infiltration.
Identifiers: Imperial Valley (Calif).

Observations and field measurements of water tables and soil salinity in the Imperial Valley indicate that depth of drainage is not solely influenced by capillary rise from the water table. Among the other influencing factors are infiltration rate, soil stratification, salinity of irrigation water, cropping pattern, irrigation practices, and hydraulic conductivity. In soils of low to moderate hydraulic conductivity the major factor in the accumulation of salts in the root zone is the low conductivity itself, making it difficult to apply enough water to satisfy leaching requirements. In such a case, capillary rise is probably a minor factor in accumulation of salts. However, in sandy soils of high hydraulic conductivity, leaching is easily achieved. Such soils permit accumulation of salts in the root zone by capillary action. Under these conditions, capillary rise may be an important cause of soil salinization. (Carr-Arizona)
W70-05292

2H. Lakes

FORMATION AND MAINTENANCE OF THERMOCLINES IN STRATIFIED LAKES INCLUDING THE EFFECTS OF POWER PLANT THERMAL DISCHARGES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 05C.
W70-05050

TEMPERATURE VARIATIONS IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and California Univ., Los Angeles. School of Engineering and Applied Science.
G. T. Orlob, and L. G. Selna.
Journal of the Hydraulics Division, ASCE, Vol 96, No HY2, Proc. Paper 7063, p 391-410, February, 1970. 10 fig, 1 tab, 19 ref.

Descriptors: *Hydraulics, *Thermal pollution, *Thermal stratification, Epilimnion, Hypolimnion, Mathematical models, Meteorological data, Reservoirs, Temperature.

A mathematical model is developed to study the thermal behavior of freshwater impoundments. The model is formulated to stimulate thermal stratification, turnover, hypolimnetic behavior, and epilimnetic behavior. In developing the model it is assumed that for the reservoir all transfers of heat energy can be accomplished along a single axis, in this case the vertical. Thus, the water body must be segmented along this axis, and the necessary water and energy equations must be written accordingly. It is concluded from the effective diffusion and temperature profiles of selected impoundments that the effective mixing in the epilimnion is greatest near the surface but declines rapidly with depth as the thermocline is approached. The effective diffusion coefficient is minimal at or very near the position of the maximum temperature gradient, the so-called 'thermocline'. In the hypolimnion the effective diffusion coefficient increases with depth in a more or less erratic manner, reaching a maximum roughly equivalent to that of the epilimnion at about mid depth, thereafter decreasing as the bottom is approached. Transfer of energy into deep stratified impoundments is accomplished by four primary mechanisms: advection, direct solar insolation, convection mixing associated with cooling at the surface and effective diffusion identified by momentum transfer. The transfer of energy from the epilimnion to the hypolimnion by the diffusive mechanism is limited at the thermocline by a strong density difference. Predicted and measured quantities show excellent comparison. (Upadhyaya-Vanderbilt)
W70-05053

WATER MASSES AND THEIR MOVEMENTS IN WESTERN LAKE ERIE,
Ohio State Geological Survey, Columbus.
Charles E. Herdendorf.
Ohio Geological Survey Report of Investigations No 74, 1969. 7 p, 4 fig, 4 ref.

Descriptors: *Lake Erie, *Limnology, *Flow, Chemical properties, Currents (Water), Water chemistry, Hydrology, Water levels, Tracking techniques.
Identifiers: Water mass movement.

A synoptic survey of several of the physical and chemical characteristics of the water in western Lake Erie was conducted on June 23, 1963. The main objective of the study was to determine the feasibility and value of a synoptic survey of water properties as a method of mapping water masses and of determining their origins and paths of movement. This basin is the recipient of large influxes of water, each with its distinctive properties, from the Detroit and Maumee Rivers and from the central basin of Lake Erie. Sampling stations were established on a two-mile grid, resulting in a total of 300 stations. At each station water samples were taken with Kemmerer water samplers at two depths: 5 feet below the surface and 2 feet above the bottom. At the time of sampling, water temperatures were measured to the nearest degree Fahrenheit. The computed velocities are generally substantiated by direct measurements. Temperature and conductivity values indicate a dominating southward movement of the Detroit River water. A northwestward flow of central Lake Erie water into the southern islands area and south of Pelee Point is also recognized. Most of the flow from western Lake Erie into the central basin appears to be through Pelee Passage. Variations in water levels, when correlated with podlike masses of water which have entered the lake from the Detroit River, provide data for determining the velocity of their movements. The average velocity of Detroit River water flow in western Lake Erie is approximately 0.5 ft/sec. (Knapp-USGS)
W70-05076

RESPIRATORY ENERGY EXPENDITURE BY THE PREDACEOUS ZOOPLANKTER LEPTODORA KINDTII (FOCKE) (CRUSTACEA: CLADOCERA),
Pittsburgh Univ., Pa. Pymatuning Lab. of Ecology; and Youngstown Univ., Ohio. Dept. of Biology.
Gerald A. Moshiri, Kenneth W. Cummins, and Robert R. Costa.
Limnology and Oceanography, Vol 14, No 4, p 475-484, 1969. 4 fig, 5 tab, 21 ref.

Descriptors: *Zooplankton, *Respiration, *Temperature, Hydrogen ion concentration, Dissolved oxygen, Crustaceans.
Identifiers: Respiratory quotient, Leptodora kindtii, Male oxygen consumption, Female oxygen consumption, Cladocera.

Oxygen consumption, carbon dioxide production, and respiratory quotients were determined for a natural population of the predaceous Leptodora kindtii during two growing seasons under a variety of laboratory conditions. The zooplankter exhibited a respiratory regulatory plateau over the temperature range from 15 to 25C. Males consumed more oxygen than fecund females. Annual respiration was calculated to be 22.5 kilocalories/cubic meter year in 1966 and 111.4 kilocalories/cubic meter year in 1967, corresponding to 4,625 and 23,302 millilliter oxygen/cubic meter year, respectively. (Wilde-Wisconsin)
W70-05085

NEGATIVE THERMAL GRADIENT UNDER ALPINE LAKE IN HAWAII,
Hawaii Inst. of Geophysics, Honolulu.
A. H. Woodcock, and Gordon W. Groves.
Deep-Sea Research, Supplement to Vol 16, p 393-405, 1969. 9 fig, 3 tab, 13 ref.

Descriptors: *Lakes, *Alpine, *Volcanoes, Ice.
Identifiers: *Lake Waiau (Hawaii), *Douglas Cone (Hawaii), *Alpine lakes, Thermal gradient, Ground ice, Cold-rim effect, Impeded seepage, Hawaii, Mauna Kea (Hawaii), Artic lakes, Warm-rim effect, Dark Lake (Wis), Perched water.

The assumption that some alpine lakes owe their origin to water perched over ground ice was tested by thermal probing of the substratum sediment of the small Lake Waiau at about 4000 meter level of the volcano Mauna Kea, Hawaii. A series of measurements established a mean negative thermal gradient of about 0.052C. The decrease in temperature of the sediment with depth may not be necessarily due to the presence of buried ice, but to a cold-rim effect transmitted by the surrounding volcanic debris. A similar, thus far unexplained, thermal condition was recently found at an arctic lake in Mackenzie River Delta, Canada. (Wilde-Wisconsin)
W70-05088

THE USE OF COPPER SULPHATE FOR ERADICATING THE PREDATORY FISH POPULATION OF A LAKE,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
M. W. Smith.
Transactions American Fisheries Society, Vol 65, p 101-114, 1935. 3 tab, 28 ref.

Descriptors: *Copper sulfate, *Population, *Lakes, Salmon, Trout, Fry, Habitat, Runoff, Organic matter, Hydrogen ion concentration, Plankton, Proteins, Inorganic compounds, Bacteria, Surfaces, Depth, Temperature, Oxygen, Bicarbonates, Algicides, Beggiatoa, Zooplankton, Copepods, Littoral, Eels, Catfishes, Killifishes, Perches, Suckers, Sticklebacks.
Identifiers: *Fish eradication, *Predatory fish, Lake Jesse (Nova Scotia), Lake Hectanooga (Nova Scotia), Hyalotheca, Tabellaria fenestrate, Aphanothece, Palmella, Kirchneriella, Asterionella formosa, Tabellaria flocculosa, Fragilaria, Cladocerans, Chironomics, Sedges, Peridinium, Dinobryon, Chrococcus, Closterium.

An experiment was attempted to create a suitable habitat for planting trout fry, by eliminating existing predatory fish populations. Copper sulphate was added to Lake Jesse, Nova Scotia, in sufficient amounts to kill most fish. Upon return to generally suitable conditions, trout fry were to be planted in both Jesse and Hectanooga Lakes, the latter serving as control. After application, water samples were analyzed for copper content. Removal of copper sulphate from Lake Jesse may have occurred by runoff, by combination with organic matter, and by precipitation with inorganic compounds. Temperature, pH value, oxygen, and bicar-

bonate observations were made. Practically all algae studied were killed by a concentration of .50 parts/million. The effective concentration varied for each species, probably depending upon temperature and chemical conditions of the waters. There was no apparent effect on rooted, submerged, and emergent vegetation, however the salt was added past the growing period. The limnetic zooplankton was completely destroyed as far as determined. Considering the dosage, it was expected that the fish of Lake Jesse would be annihilated, which proved correct, but an undeterminable number of fish did survive. (Jones-Wisconsin)
W70-05090

AGE AND MORPHOLOGY OF SMALL LAKE BASINS, SOUTHERN HIGH PLAINS, TEXAS AND EASTERN NEW MEXICO,
Texas Technological Coll., Lubbock. Dept. of Geology.
C. C. Reeves, Jr., and W. T. Parry.
The Texas Journal of Science, Vol 20, No 4, 349-354, 1969. 3 fig, 8 ref.

Descriptors: *Lakes, *Basins, Age, Lake morphology, Sand dunes.
Identifiers: *West Texas, *New Mexico, Southern High Plains, Small lake basins, Tahoka age, Pliocene caliche, Vigo park, Altithermal, Deflation basin.

The southern High Plains of west Texas and eastern New Mexico are pockmarked by thousands of small, dry lake basins, the majority of which are 20-30 feet deep and about 1/4 to approximately one mile in diameter. Transverse dunes which fringe on many of the larger basins indicate a deflation origin. Dunes associated with the older basins indicated a S 30-80 degree east prevailing wind which places their formation sometime during the 5,000-25,000 B P period. Other lines of evidence suggest the Vigo Park and Altithermal intervals, 17,000 and 6,500-5,000 years B P. The small, younger basins, without fringe dunes, represent deflation during the last few thousand years or natural topographic undulations. However, some also represent larger basins that have been nearly filled with lacustrine sediment. The morphology of the lakes is described: basins along abandoned stream channels are elongated; recent basins are circular; and older basins are subcircular to elliptical. (Haskins-Wisconsin)
W70-05095

CHEMICAL CHARACTERISTICS OF ONTARIO LAKES AS RELATED TO GLACIAL HISTORY,
Department of Lands and Forests, Maple (Ontario). Research Branch.
R. A. Ryder.
Transactions American Fisheries Society, Vol 93, p 260-268, 1964. 8 fig, 14 ref.

Descriptors: *Productivity, *Alkalinity, *Dissolved solids, *Lakes, Glacial drift, Chemical properties.
Identifiers: *Glacial regions, *Ontario lakes, Canada, Precambrian Shield Regions, Extinct Pleistocene lakes, Regions of Past Marine Submergence.

More accurate prediction of potential biological productivity are possible by interpreting relationships between dissolved solids and alkalinity in a lake. Surface water samples were collected from 310 Ontario lakes over a three year period and analyzed for total alkalinity and dissolved solids. Seasonal changes in dissolved solids concentrations were found, with high concentration after ice breakup due to turnover and runoff. Peak concentrations were in August as a result of wind mixing. Total alkalinity varied less than total dissolved solids. Total dissolved solids and alkalinity varied witin watershed according to glacial history. Precambrian Shield Regions have lower concentrations than Extinct Pleistocene Lakes and Regions of Past Marine Submergence. Concentration variations within glacial regions depend upon depth of glacial drift and sedimentary materials. Little drift material results in low concentration. Mean ratio of total alkalinity to total dissolved solids is 57:100 from which a general relationship is derived. Classifying lakes according to glacial region is a simple way of ranking lakes according to productivity. (Bannerman-Wisconsin)
W70-05097

CHANGES IN ENVIRONMENT AND BIOTA OF A NATURAL LAKE AFTER FERTILIZATION,
Fisheries Research Board of Canada, St Andrews (New Brunswick). Biological Station.
M. W. Smith.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3101-3132, 1969. 10 fig, 10 tab, 41 ref, appendix.

Descriptors: *Lakes, *Fertilization, *Fertilizers, Nitrogen, Phosphorus, Potassium, Oligochaetes, Gastropods, Phytoplankton, Zooplankton, Benthic fauna, Daphnia, Rotifers.
Identifiers: *Crecy Lake (Canada), Soft water lakes, Artificial enrichment, Inorganic fertilizers, Anabaena, Spirogyra, Isoetes, Juncus, Sparganium, Hyalella, Leptodiaptomus, Chironomidae, Hirudinae, Odonates, Sphaeriids.

Crecy Lake, New Brunswick, was enriched on three occasions (1946, 1951, 1959) with inorganic commercial fertilizers, each application sufficient to provide 210, 390 and 270 parts/billion of nitrogen (N), phosphorus (P), and potassium (K), respectively, when uniformly distributed. Concentrations of P (inorganic, organic, total) declined rapidly after fertilization. Loss of P owing to drainage amounted to 8.5-.2% of amounts added. Nitrate N concentrations rose sharply but rapidly fell to prefertilization values. Anabaena and Spirogyra blooms followed each fertilization; Anabaena blooms continued under the ice cover. Rooted aquatic vegetation increased somewhat; Isoetes and Juncus were adversely affected by algal blooms. Although Isoetes recovered well following blooms, only Sparganium appeared to benefit from fertilization. Average dry weight of zooplankton increased with each fertilization; quantities were depressed during Anabaena blooms. Peak effects on zooplankton appeared to occur at 2-4 years post-fertilization. Only Daphnia and Diaphanosoma increased appreciably due to fertilization. Hyalella azteca increased after each fertilization; population levels were in part directly related to abundance of Isoetes. Chironomids, sphaeriids and oligochaetes increased irregularly. Crecy Lake is sufficiently self-regulating that artificial enrichment was temporary and induced eutrophication was largely reversible. (Voigtlander-Wisconsin)
W70-05104

REPORT UPON THE CAUSE OF OFFENSIVE ODORS FROM LAKE MONONA, MADISON, WISCONSIN,
Alvord, Burdick and Howson, Chicago, Ill.
J. W. Alvord, and C. B. Burdick.
Engineering Report to the Mayor and City Council of Madison, Wisconsin, May 1920. 121 p. 11 fig, 10 tab, 20 ref.

Descriptors: *Odor, *Lakes, *Wisconsin, Sewage treatment, Sugar beets, Cyanophyta, Storm runoff, Winds, Decomposing organic matter, Copper sulfate, Nitrates, Nitrogen, Nitrites, Effluents, Industrial wastes, Agriculture, Drainage, Kentucky, Denitrification, United States, Minnesota, Reservoirs, Plankton, Water pollution, Diatoms, Diversion, Clathrates.
Identifiers: *Lake Monona (Wis), *Madison (Wis), Stench, Periodic recurrence, Winchester (Ky), St Paul (Minn), Lake Winnebago (Wis), Belfast (Ireland), Lake Vadnais (Minn), Clathrocystis.

Extremely offensive odors emanated from Lake Monona during the 1918 summer and fall; equally disagreeable odors were recorded for 1882, 1898, and 1913. These odors prevailed over and the periphery of the lake and were localized except when dissipated by winds, drift, and humidity, with the exception of certain bays. Blue-green algae were abundant at many points; masses of decaying algae stranded on the shores, if stirred with a stick, looked like human excrement, and smelled exactly like odors from a foul and neglected pig sty. Offensive algal growth is common, especially in shallow lakes, and often in pure water of many water works reservoirs. Although sewage may, to some degree, stimulate algae growth, they would be sufficiently luxuriant from natural causes to constitute a nuisance, even if the sewage or effluent were not allowed to reach the lake or were subject to treatment to exclude such nitrogenous matter that helps support algae. Increased knowledge of algal physiology and factors favoring plant growth is needed. Toxic doses of copper sulfate should be applied when necessary, which will be adequate to keep the algae under control and suppress it only when extensive growth threatens. (Jones-Wisconsin)
W70-05107

THE MADISON LAKES PROBLEM,
G. A. Rohlich, A. S. Johnson, G. V. Fitzgerald, George J. Schroepfer, and R. A. Bryson.
Report on investigation of a project sponsored by Oscar Mayer and Co, Madison, Wisconsin, September 15, 1955. Part I: 31 p, 17 fig, 13 tab, 9 ref; Part II: 90 p, 53 fig, 39 tab, appendix; Summary and a Program for Resolution of the Problem, 15 p.

Descriptors: *Lakes, *Wisconsin, *Eutrophication, *Chemicals, *Hydrographs, Sewage effluents, Water pollution control, Water pollution sources, Water pollution effects.
Identifiers: *Madison (Wis), Yahara River watershed, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

This two-part report summarized results of the previous and 1955 studies of complex problems relevant to pollution of four large lakes in the vicinity of Madison, Wisconsin. The scope of investigations embraced physical, chemical, and biological conditions of the lakes, factors related to diversion of sewage effluent, possibilities of controlling addition of nutrients, and management potentialities of the Yahara River watershed. The report is supplemented by a 15-page summary of investigations and a program for resolution of the problem. The question of effluent disposal requires additional information on the composition of Madison lakes, connecting rivers, and Badfish Creek-Yahara River-Rock Creek system. The major channels toward reduced eutrophication include removal of nutrients from effluent by irrigation, or chemical and physical methods, use of stabilization ponds, and diversion of Door Creek, an important contributor of nutrients. Shoreline sanitation and weed harvesting, and elimination of rough fish are other means of decreasing the nutrient content of these lake waters. (Wilde-Wisconsin)
W70-05110

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1942 TO JULY 1943,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
C. N. Sawyer, J. B. Lackey, and A. T. Lenz.
Report to Governor's Committee, Madison, Wisconsin, 1943. 79 p. 15 fig, 4 tab, 22 ref, Appendix.

Descriptors: *Odor-producing algae, *Nuisance algae, *Wisconsin, *Lakes, Productivity, Nitrogen, Phosphorus, Drainage, Marshes, Farms, Cyanophyta, Plankton, Zooplankton, Eutrophication, Storm drains, Sewage effluents, Streamflow, Measurement, Water pollution, Fertilization, Industrial wastes, Garbage dumps, Oil wastes, Inlets (Waterways), Organic matter, Potassium, Sulfates,

Crustaceans, Diatoms, Copper sulfate, Dinoflagellates, Euglenophyta, Chlorophyta, Chlamydomonas, Fungi.
Identifiers: *Madison (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Blooming, Lake Mendota (Wis), Lake Wingra (Wis), Anabaena spiroides, Microcystis aeruginosa, Cryptomonadida, Mastigophora, Cryptophyceae, Chrysophyceae, Volvocales, Sarcodina, Ciliates, Cyclotella, Aphanizomenon flos aquae, Melosira, Asterionella formosa, Fragilaria, Stephanodiscus, Pandorina.

Madison lakes, especially the shallow downstream lakes below the city, have been troubled during warm seasons with offensive odors and unsighlty shorelines. The major cause of the offensive conditions are a direct result of accumulations of algal growths in advanced stages of decomposition. These growth stimulations are related to fertilization of the water with minerals, such as nitrogen, phosphorus, potassium, and possibly other enriching elements and compounds. Drainage from rich agricultural areas and urban communities into shallow lakes enhances algal problems. Nitrogen is shown to be one of the major componential elements, with phosphorus minor. Nuisances in inland lakes are largely members of the plant kingdom. Domestic sewage, although highly purified by modern treatment methods, is rich in phosphorus, nitrogen, potassium, and possibly other elements. The most obnoxious blooms are those of blue-green algae, particularly Anabaena and Microcystis. Excessive amounts of plankton are related to agricultural drainage. Lakes Monona, Waubesa, and Kegonsa are additionally enriched by storm sewers, other than rain water, and by sewage treatment plant effluent. (See W70-05113). (Jones-Wisconsin)
W70-05112

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1943 TO JULY 1944,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
C. N. Sawyer, J. B. Lackey, and A. T. Lenz.
Report to Governor's Committee, Madison, Wisconsin, 1945. 92 p. 23 fig, 29 tab, Appendix.

Descriptors: *Algae, *Lakes, *Eutrophication, *Hydrology, Chemical properties, Wisconsin, Sewage effluents, Nitrogen, Phosphorus.
Identifiers: *Truax Field (Madison) effluents, *Madison lakes, Yahara River (Wis), Storkweather Creek (Wis), Nine Springs Creek (Wis), Door Creek (Wis), Dutch Mill Drainage Ditch (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

The three parts of this voluminous report present results of detailed hydrological, chemical, and biological investigations of the three Madison lakes and their tributaries. The study confirmed that the objectional growth of algae and lake bloom are primarily induced by inorganic forms of nitrogen and phosphorus of sewage effluents. Nuuisance blooms are attributed chiefly to blue-green algae. The results of laboratory experiments indicated that removal of soluble nitrogen and phosphorus from sewage would materially decrease the algal density. The critical contents of nitrogen and phosphorus in the lake waters were established as 0.30 and 0.015 ppm, respectively. A suggestion is made to duplicate laboratory trials in artificial ponds treated with sewage and sewage freed from its nitrogen and phosphorus. (See W70-05112). (Wilde-Wisconsin)
W70-05113

CHEMICAL AND THERMAL CHARACTERISTICS OF KEYSTONE RESERVOIR,
Oklahoma Water Resources Research Inst., Stillwater.
Troy C. Dorris.
Available from the Clearinghouse as PB-190 571, $3.00 in paper copy, $0.65 in microfiche. Oklahoma University Water Resources Research Institute Project Completion Report, 1969. 191 p, 51 fig, 46 tab, 168 ref, append. OWRR Project No. A-002-OKLA.

Descriptors: *Limnology, *Reservoirs, Water quality, Dissolved oxygen, Water temperature, Discharge (Water), Stratification, Nutrients, Eutrophication, Heat budget, Data collections, Hydrologic data, Computer programs.
Identifiers: Keystone Reservoir (Okla).

Physicochemical limnology of Keystone Reservoir during 1965-66 was compared to 1966-67. Spatial and temporal variations in the rate of community metabolism in the Cimarron arm during 1966-67 were estimated. A change from epilimnetic reservoir discharge during 1965-66 to hypolimnetic discharge during 1966-67 produced marked differences in the intensity of stratification, circulation patterns and effects of impoundment on water quality. Approximately 86% of the average annual inflow of suspended solids from the Cimarron River was lost to sediments. The average annual heat budget of Keystone Reservoir was 17,217 cal per sq cm, and the reservoir had an average negative winter heat income of -995 cal per sq cm. Concentrations of total phosphorus increased with depth and decreased downstream. Total phosphorus content of the Cimarron arm increased from 14.3 to 45.8 metric tons between September 1966 and August 1967. Biochemical and chemical oxygen demands decreased downstream and were inversely related to water temperature. Community respiration accounted for 80.0% of average oxygen losses while diffusion-out accounted for 19.7% and reservoir discharge accounted for 0.3%. (Knapp-USGS)
W70-05121

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 02D.
W70-05208

A LIMNOLOGICAL INVESTIGATION OF WATER QUALITY CONDITIONS IN LAKE SAMMAMISH,
Seattle Metropolitan Municipality, Wash.
For primary bibliographic entry see Field 05C.
W70-05256

EFFECTS OF THERMAL STRATIFICATION AND NUTRIENT AVAILABILITY ON THE PRODUCTIVITY OF RESERVOIR PHYTOPLANKTON,
Tennessee Valley Authority, Chattanooga. Biology Section.
For primary bibliographic entry see Field 05C.
W70-05274

DISTRIBUTION AND ABUNDANCE OF PHYTOPLANKTON AND ROTIFERS IN A MAIN STEM MISSOURI RIVER RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
Patrick L. Hudson, and Bruce C. Cowell.
Proceedings of South Dakota Academy of Science, Vol 45, p 84-106, 1966. 7 fig, 5 tab, 16 ref.

Descriptors: *Reservoirs, *Phytoplankton, *Rotifers, *Distribution, Missouri River, South Dakota, Nebraska, Algae, Nannoplankton, Diatoms.
Identifiers: *Lewis and Clark Lake (S D), Abundance, Blue-green algae, Green algae, Fragilaria, Asterionella, Melosira, Microcystis, Keratella, Polyarthra, Asplanchna, Branchionus.

Weekly samples were taken at ten stations in Lewis and Clark Lake Reservoir, bordering South Dakota-Nebraska, from May to October; additional samples were obtained from an automatic plankton sampler at the discharge. Mean numbers of net phytoplankton increased from headwaters to the dam; volumes of net phytoplankton per liter of water varied irregularly throughout the reservoir. Data from the reservoir discharge indicate nannoplankton comprised 84% of phytoplankton volume. Discharge of phytoplankton totalled 9,058 metric tons for one year with peak discharges occurring in March, May and August. Phytoplankton discharge does not appear to be directly related to volume of water discharged. Diatoms were dominant phytoplankter in all months except August (green algae) and October (blue-green algae). Abundance of rotifers increased from headwaters downstream. Dominant rotifers in terms of months present and mean numbers per liter were Polyarthra, Asplanchna and Keratella; ten additional genera were noted. Seasonal abundance figures indicate a single peak in late spring--early summer. Highest total mean values occurred in April and June; lowest totals were in November and January. Graphical and tabular data include monthly averages of phytoplankton and rotifer densities. (Voigtlander-Wisconsin)
W70-05375

THE PHYSICAL-CHEMICAL LIMNOLOGY OF A NEW RESERVOIR (BEAVER) AND A FOURTEEN YEAR OLD RESERVOIR (BULL SHOALS) LOCATED ON THE WHITE RIVER, ARKANSAS AND MISSOURI,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
James W. Mullan, and Richard L. Applegate.
Southeastern Association of Game and Fish Commissioners 19th Annual Conference, p 413-421, 1965. 4 fig, 1 tab, 8 ref.

Descriptors: *Reserviors, *Limnology, *Physicochemical properties, Arkansas, Missouri, Temperature, Dissolved oxygen, Transparency, Water circulation, Thermal properties, Phosphorus, Nitrogen, Organic matter, Conductivity, Heat budget, Chemical analysis.
Identifiers: Beaver Reservoir (Ark-Mo), Bull Shoals Reservoir (Ark-Mo), White River (Ark-Mo), Arkansas-Missouri Ozarks.

Beaver and Bull Shoals Reservoirs are similar in mean depth, maximum depth, bottom slope and shoreline development factor; they differ in age and size. Maximum transparency in Bull Shoals occurred in early fall (Secchi disk = 7 meters), minimum transparency occurred in early spring (0.3 to 3.7 meters). Values for Beaver were 30 to 65% of Bull Shoals; maximum value was 4 meters. Both reservoirs stratified in June; annual heat budgets were 27,800 to 28,300 gram-calories for Bull Shoals, and 20,700 for Beaver. Bull Shoals showed higher alkalinity (pH 7.9 vs 7.0 for Beaver, median total alkalinity 130 vs 60 for Beaver). Dissolved organic matter in Bull Shoals was about 83 to 86% of that recorded in Beaver (medians for two years of 6.1 and 5.4 milligram/liter vs 7.1 and 6.5 for Beaver). Beaver had slightly higher concentrations of nitrogen, phosphorus and some trace elements. Although this may indicate slightly greater nutrient availability in the younger reservoir, measurements of all parameters failed to demonstrate a significantly higher nutrient base in Beaver Reservoir. Graphical and tabular data include temperature, heat content and dissolved oxygen profiles and a complete summary of chemical analyses (25 parameters) for both reservoirs. (Voightlander-Wisconsin)
W70-05380

SAMPLING RESERVOIR FISH POPULATIONS USING MIDWATER TRAWLS,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark. South Central Reservoir Investigations.
Alfred Houser, and Horace E. Bryant.
Reservoir Fishery Resources Symposium, Athens, Georgia, April 5-7, p 391-404, 1967. 4 fig, 8 tab, 9 ref.

Descriptors: *Methodology, *Fish populations, *Reservoirs, Standing crop, Mortality, Sampling, Arkansas, Pounds fish per acre, Analytical techniques, Impoundments, Forage fish, Fish, Missouri.
Identifiers: Warm water fish, Threadfin shad, Gizzard shad, Bull Shoals Reservoir (Ark-Mo), White River (Ark-Mo), Beaver Reservoir (Ark-Mo), Population estimates, Mortality coefficients.

A midwater trawling technique and analytical procedures for population estimates were employed in Bull Shoals and Beaver Reservoirs on the White River. Emphasis was placed on evaluating the utility of midwater trawling methods for population analysis. Of 16 fish species captured, only two, gizzard and threadfin shad, yielded sufficient numbers for population estimates. Trawling was carried out in 8-foot vertical strata throughout the summer; population estimates were based on catch/unit of effort in each stratum. Both shad species showed dramatic young-of-the-year losses through summer. In Beaver Reservoir, young threadfin shad decreased from 290 million in July to 42 million fish in September; young gizzard shad decreased from 244 million to 2 million over the same period. For 0-age threadfin, mortality coefficients (M) as defined by the expression N-sub-1/N-sub-2=exp (-Mt), where t is time interval (in months) between two succession population estimates, N-sub-1 and N-sub-2, were 0.36 for July-August, and 1.56 for August-September. Similar estimates for gizzard shad were 1.90 and 2.95. Standing crops of both shad in Beaver Reservoir were estimated respectively at 10.1 and 21.3 kilograms/hectare for July, 19.1 and 4.5 for August, and 7.8 and 0.4 for September (converted from lbs/acre). (Voigtlander-Wisconsin)
W70-05382

REFLECTIONS ON WATER,
Minnetonka Herald, Minn.
Hibbert Hill.
Northern States Power Company, Minneapolis, Minnesota, 95 p, 1968. 2 fig, 2 tab.

Descriptors: *Lakes, *Ponds, *Algae, *Plankton, *Ecology, Limnology, Thermal properties, Mudwater interfaces, Algae, Aquatic animals, Seasonal, Spawning, Pondweeds.
Identifiers: *Christmas Lake (Minn), Wild celery, Hydra, Pediastrum, Closterium, Euglena, Volvox, Oscillatoria, Spirogyra, Vorticella, Anabaena flos aquae, Blue-green algae.

Amateur naturalists can make important contributions to knowledge of eutrophication. Lakes, which are an integral part of our landscape are not merely summer or winter playgrounds, but objects worthy of scientific study. 'Reflections on Water' is a compilation of essays, originally published as a weekly column in the Minnetonka Herald (Minnesota). Although the author has an engineering background, there is nothing amateurish in his study approach or description of Christmas Lake, Minnesota. The aquatic biology of the lake was studied in detail and followed for a year of its life cycle. Temperature changes, plankton, including important algae, fish and other animals, physical limnology, aquatic higher plants, and sediments are described. Many important, yet unresolved, problems are described. This is an entertaining work, but the real value of 'Reflections on Water' lies in its demonstration that enthusiastic, but disciplined laymen can make extremely valuable contributions to understanding environmental problems. (Gerhold-Wisconsin)
W70-05386

ALGAE AND PHOTOSYNTHESIS IN SHAGAWA LAKE, MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Robert O. Megard.
University of Minnesota, Minneapolis, Limnological Research Center, Interim Report No 5, April 1969. 5 fig, 10 tab, 8 ref.

Descriptors: *Algae, *Photosynthesis, *Minnesota, Phytoplankton, Cyanophyta, Diatoms, Stratification, Oxygen, Hydrogen ion concentration, Temperature, Depth, Density, Chlorophyll, Ice, Seasonal, Diurnal, Light intensity, Carbon, Sewage treatment, Tertiary treatment, Effluents, Limnology, Water chemistry, Respiration, Bathymetry, Salinity, Phosphorus, Productivity, Chlorophyta, Chrysophyta, Scenedesmus, Standing crop.
Identifiers: *Shagawa Lake (Minn), Aphanizomenon flos aquae, Stephanodiscus astrea, Lake Minnetonka (Minn), Morphometry, Algae blooms, Clearwater Lake (Minn), Trout Lake (Minn), Kimball Lake (Minn), Cryptophyta, Pyrophyta, Chroomonas acuta, Schroederia setigera, Melosira ambigua, Ceratium hirudinella, Ankistrodesmus, Glenodinium pulvisculus, Scenedesmus quadricauda.

Shagawa Lake (Minnesota) phytoplankton was dominated by Aphanizomenon flos aquae in summer and Stephanodiscus astrea var minutula in winter, mainly concentrated in depths above 4 meters. Chlorophyll content of Aphanizomenon filaments in different parts at the lake surface were similar on any date but decreased 40% in two weeks, a possible response to recent photic history or population aging. Chlorophyll concentrations and algal densities beneath March ice were greater than in some parts of the lake during summer. When algae from different localities were incubated at 0.5 meter depth (light intensities optimal for photosynthesis on sunny days), average daily rate of photosynthetic carbon assimilation was 42 micrograms carbon/microgram chlorophyll, identical to the rate at the same temperature in Lake Minnetonka. The dense algal populations in surface waters absorbed so much light that there was little photosynthesis below 3 meters. Algal photosynthetic capacity beneath almost one meter clear ice nearly equalled that of cloudy summer days. Effects of algal photosynthetic capacity were measured on varying amounts of effluent from secondary and tertiary waste treatment plants. Photosynthesis was stimulated slightly by tertiary effluent, but halted by 20% municipal water. (See also W69-00659, W69-10167). (Jones-Wisconsin)
W70-05387

MEASUREMENTS OF EUTROPHICATION AND TRENDS,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05C.
W70-05394

ON THE VARIATION IN BOTTOM FAUNA AND FISH YIELD IN RELATION TO TROPHIC LEVEL AND LAKE DIMENSIONS,
Dalhousie Univ., Halifax (Nova Scotia).
F. R. Hayes.
Journal Fisheries Research Board of Canada, Vol 14, No 1, p 1-32, 1957. 6 fig, 8 tab, 95 ref, appendix.

Descriptors: *Lakes, *Depth, *Dimensions, *Trophic level, Fauna, Productivity, Fish populations, Fish, Food chains, Measurement, Dimensional analysis.
Identifiers: *Lake capacity, Canadian lakes productivity, Productivity index, Fish yield.

A study of 500 lakes indicates that up to 0.3 square kilometer lakes have a mean depth of 3 to 4 meters; the depth of larger lakes tends to follow a linear log-log plot relationship. The productivity index was calculated for about 150 lakes by factoring fish records into three trophic levels: short food chain (carp), intermediate (bluegills), and long food chain (trout, bass). This index was inversely proportional to mean depth on a log-log plot. By correction of the productivity index, a theoretical value--the quality index--was derived for a standard lake 5 meters deep. The quality index screens the effect of depth and reveals the inherent capacity of the lake. A survey of bottom fauna in 250 lakes failed to provide a correlation between depth and productivity. (Wilde-Wisconsin)
W70-05397

ON THE THEORY OF ADDING NUTRIENTS TO LAKES WITH THE OBJECT OF INCREASING TROUT PRODUCTION,
Dalhousie Univ., Halifax (Nova Scotia). Zoological Lab.
F. R. Hayes.
Canadian Fish Culturist, Vol 10, p 32-37, 1951. 13 ref.

Descriptors: *Nutrients, *Lakes, *Trout, *Fish management, Fertilization, Algae, Plankton, Nitrogen, Phosphorus, Potassium, Selectivity, Poisons, Oxygen, Tracers, Phosphorus radioisotopes, Ions, Humic acids, Carp, Ice, Iron compounds, Hydrogen ion concentration, Acidity, Mud, Hydrogen sulfide.
Identifiers: Prince Edward Island (Canada), Nova Scotia (Canada), Penguins, Lake Zurich (Switzerland), Whitefish, Punchbowl Lake (Canada).

When nutrient salts are added to lakes for fertilization, 90% may disappear in an exchange reaction, within a few weeks. The remaining 10% is likely to remain in or available to the water contributing to algal growth, leading to animal plankton growth, and thence to fish growth. None of the extra material is probably seen during the second summer. While information is less complete regarding potassium and nitrogen, than phosphorus, the view is that about the same percentage of each would survive in water after equilibration. As a conservation measure, fertilization of lakes does not appear to be an economically feasible procedure, although it constitutes an interesting experiment for a privately controlled lake. If there are no coarse fish to replace trout under high fertility conditions, large trout yields may be expected. This seems the situation in Prince Edward Island. Alternatively coarse fish might be selectively poisoned in conjunction with a fertilization program. Selective poisoning, by removing coarse fish from shallows while leaving trout in the depths, has been found promising. It may be that trout survive where they do, because they can tolerate more adverse conditions than competing fish. (Jones-Wisconsin)
W70-05399

PIGMENTS FROM THE BOTTOM DEPOSITS OF AN ENGLISH LAKE,
University Coll., London (England). Dept. of Botany.
G. E. Fogg, and J. H. Belcher.
New Phytologist, Vol 60, p 129-142, 1961. 8 fig, 22 ref, appendix.

Descriptors: *Sediments, *Lakes, *Pigments, Chlorophyll, Chromotography, Spectrophotometry, Forests.
Identifiers: *Acetone-soluble pigments, Chlorophyll degradation, Deforestation, Carotenes, Lutein, Carotenoids, Esthwaite Water (England), English Lake District.

Chromotographic and spectrophotometric identification of acetone-soluble pigments from the Esthwaite Water sediment revealed that these chlorophyll degradation products are similar to those of North American lakes. The main components of pigments, and beta-carotenes, lutein, and epiphasic carotenoids showed a general correlation with the amount of organic matter at different depths and with the past ecological changes. The ratio of chlorophyll degradation products to epiphasic and hypophasic carotenoids remained constant to the depth of 100 centimeters, but lutein showed a retarded decomposition. The results suggest regular changes of environment from the Boreal period, and a radical alteration of the milieu in about A D 1000, inflicted by deforestation. (Wilde-Wisconsin)
W70-05402

LIMNOLOGICAL RELATIONS OF INDIAN INLAND WATERS WITH SPECIAL REFERENCE TO WATERBLOOMS,
University Coll., London (England). Dept. of Botany.
R. N. Singh.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 12, p 831-836, 1953. 16 ref.

Descriptors: *Limnology, *Water, *Rivers, *Lakes, *Ponds, Light, Temperature, Fertilization, Fish, Nuisance algae, Odor, Taste, Depth, Circulation, Diurnal, Winds, Currents (Water), Water pollution, Drainage, Organic matter, Sewage, Phytoplankton, Productivity, Chlorophyta, Hydrogen ion concentration, Nitrates, Phosphates, Cyanophyta, Oxidation-reduction potential, Bottom sediments, Euglenophyta, Toxicity.
Identifiers: *India, *Blooms, River Ganges (India), Rajghat (India), Bombay (India), Benares (India), Macrophytes, Cladophora, Oedogonia, Spirogyra, Microcystis aeruginosa, Anabaenopsis, Raciborskii, Raphidiopsis, Anabaena, Wollea, Oscillatoria, Spirulina, Volvocales, Glenodinium, Trachelomonas.

Indian waters are infested with water blooms. Experiments with bloom types and their effect on animals proved that Indian water blooms are never toxic although the same algal species are poisonous in other countries. Blue-green algae encourage growth of fish which feed upon them directly or indirectly, providing an excellent source of fertilization of a pond. The bloom can also be utilized as green manure; dried bottom muds are used as a manure source. The algae blooms are initailly saprophytic--significant in view of their sudden appearance after a long absence. In the Ganges, the algal flora is typically Chlorophycean, but a marked change occurs when the river receives sewage or effluent, then a Myxophycean bloom is formed. Samples of algae bloom dried for fertilization of hatchery ponds have been prepared which can be inoculated and grown successfully. A biological method of control by introducing fish and crustaceans for food utilization might be envisaged. When bloom disintegration has reached a maximum and temperature is high, a pond may be covered with dead fishes involving economic loss. (Jones-Wisconsin)
W70-05404

THE EUTROPHICATION OF LAKE KLOPEINER (In German),
Biologische Station Lunz (Austria).
I. Findenegg.
Oesterreichische Wasserwirtschaft, Vol 17, No 7-8, p 175-181, 1965. 4 fig, 3 tab.

Descriptors: *Eutrophication, Temperature stratification, Depth, Plankton, Light penetration, Seasonal, Primary productivity, Calcium, Nitrates, Ammonia, Phosphates, Hydrogen ion concentration, Phytoplankton, Odor, Winds, Epilimnion, Hypolimnion, Light intensity, Conductivity, Algae, Sewage, Diatoms, Cyanophyta, Carbon radioisotopes, Potassium, Oxygen.
Identifiers: *Lake Klopeiner (Austria), Lake Worther (Austria), Vertical, Chalk, Metalimnion, Oscillatoria rubescens, Dinobryon, Uroglena americana, Cyclotella, Ceratium hirundinella, Peridinium willei, Chlorococcales, Ankistrodesmus, Oocystis, Cryomonas erosa, Cosmarium, Chrococcus limneticus, Lyngbya limnetica, Anabaena flos aquae, Tabellaria, Melosira, Fragilaria crotonensis, Aphanizomenon.

Lake Klopeiner, Austria, despite heavy sewage influx, has not progressed far in eutrophication, although considerable amounts of nutrients have accumulated in the depths as a result of meromixis. This meromictic behavior is the key to understanding the stratification of oxygen and its changes since 1931. The zone free of oxygen expanded upward during the course of the decades and lay between 20 and 35 meters in 1935 and is now elevated to a level between 10-25 meters. This meromictic behavior in winter and the strict separation of both epi- and hypolimnion in summer give a special character to the course of eutrophication. The lake has an unusual thermic position: seldom disturbed by winds and then only for short periods, it has no strong currents; local breezes distribute the surface water, warmed by sunshine, only within a thin layer of epilimnion. An increase in amount of algae is due to the immigration of a species of plankton, the blood alga (Oscillatoria rubescens), not observed before. This species is regarded as an indicator of increasing eutrophication accelerated by domestic sewage. There is also a decrease of transparency. (Jones-Wisconsin)
W70-05405

THE ECOLOGICAL SIGNIFICANCE OF CLADOCERAN REMAINS IN LAKE SEDIMENTS,
Indiana Univ., Bloomington. Dept. of Zoology.
David G. Frey.
Ecology, Vol 41, No 4, p 684-699, 1960. 30 fig, 7 tab, 58 ref.

Descriptors: *Lakes, *Sediments, Biomass, Plankton, Nitrogen (Organic).
Identifiers: Cladocerans, Lake Ontogeny, Madison lakes (Wis).

This study of cladoceran remains in sediments of Madison lakes (Wisconsin) recovered nearly all previously reported species and disclosed six new ones. The four lakes studied show a regular gradation of the total population densities of remains correlated with the mean biomass of plankton and organic nitrogen content. A decrease in size and depth of the lake corresponds to a lower density of Daphnia and a higher abundance of Bosmina and non-planktonic Chydorus spp. (Wilde-Wisconsin)
W70-05406

THE WATERS OF MEROM: A STUDY OF LAKE HULEH. I. INTRODUCTION AND GENERAL STRATIGRAPHY OF A 54 M CORE,
Pittsburgh Univ., Pa. Dept. of Biology.
Ursula M. Cowgill.
Archiv fur Hydrobiologie, Vol 66, No 3, p 249-272, 1969. 9 fig, 1 tab, 28 ref.

Descriptors: *Lakes, *Cores, Sedimentation rates, History, Peat, Maps, Geological surveys, Vegetation.
Identifiers: Carbon-14 analysis, Lake Huleh (Israel), Jordan Valley, Waters of Merom (Israel), Israel.

This study of a 54-meter core, drilled in the center of drained Lake Huleh in the Jordan Valley, Israel, revealed the previous existence of a swamp which was later converted into a lake, presumably by damming the Jordan River. According to carbon-14 analyses, the alteration took place some 30,000 years ago. The distribution of macroscopic plant remains and shells suggests a prevalence of limnetic conditions during the deposition of the sediment 20-25 meters below the present surface. The surface 7 meters of the sediment were deposited during historic times. The low sedimentation rate of only 0.034 centimeter/year rose to 0.45 centimeter/year some 8,000 to 9,000 years ago, and then fell to about 0.16 centimeter/year over the past two-and-one-half millenia. (Wilde-Wisconsin)
W70-05407

THE DYSTROPHIC LAKE TYPE,
Copenhagen Univ. (Denmark). Geographical Lab.
Kaj Hansen.
Hydrobiologia, Vol 19, p 183-191, 1962. 30 ref.

Descriptors: *Lakes, *Dystrophy, Acidity, Humus, Sediments, Soil types, Swamps, Peat.
Identifiers: Carbon:nitrogen ratio, Dy sediments, Tyrfopel sediments, Oligohumus, Euhumus.

The identifying characteristics of dystrophic lakes of either oligotrophic or eutrophic nature include the presence of acid humus in water and in the sediment, carbon:nitrogen ratio exceeding 10, and an excess of production of organic matter over its decomposition. The sediments are of dy or tyrfopel, rather than gyttja type. An increase in the content of acid humus is paralleled by changes in composition of plant and animal communities. In advanced stages of development, dystrophic lakes are replaced by peat deposits. (Wilde-Wisconsin)
W70-05408

ENVIRONMENTAL REQUIREMENTS OF FRESH-WATER PLANKTON ALGAE,
Uppsala Univ. (Sweden). Inst. for Physiological Botany.
Wilhelm Rodhe.
Symbolae Botanicae Upsalienses, Vol 10, No 1, p 1-149, 1948. 33 fig, 30 tab, 96 ref.

Descriptors: *Environment, *Fresh water, *Plankton, *Algae, Scenedesmus, Light, Cultures, Iron compounds, Diatoms, Cyanophyta, Phosphates, Chlorophyll, Magnesium, Potassium, Temperature, Epilimnion, Light intensity, Seasonal, Physiological ecology, Ecotypes, Chlorophyta, Photometry, Chlorella, Nutrients, Trace elements, Chlamydomonas, Chrysophyta, Nitrates, Plant growth, Bicarbonates, Depth.
Identifiers: *Requirements, Scenedesmus, Absorption, Cell concentration, Uroglena, Ankistrodesmus, Chlorococcales, Volvocales, Conjugatae, Heterokontae, Gloeotrichia, Asterionella, Dinobryon, Melosira, Aneboda (Sweden), Uppsala (Sweden), Lake Erken (Sweden), Extinction values, Eudorina, Culture medium, Coelastrum, Pediastrum.

This work elucidates the influence of some environmental factors on freshwater plankton algae. The requirements of some algae, especially Scenedesmus quadricauda, were studied in cultures under controlled conditions and compared with lake conditions. Substance production, cell multiplication, and chlorophyll formation are rather independent aspects of the development of a culture. Parallel determinations should be carried out for the different parameters. Alpha a-dipyridyl and o-phenanthroline are sensitive and reliable reagents for determination of iron in water. In light, one part critric acid to one part ferric citrate has a stabilizing effect sufficient for algal cultures. A culture solution was composed suitable for unlimited cultivation of about 40 species and forms belonging to Chlorococcales, Volvocales, Conjugatae, Heterokontae, and diatoms. The phosphate dependence of growth can differ for various plankton algae. Experimental results with Dinobryon and Uroglena suggest that phosphorus, even in ordinary lakes, may become a maximum factor for some algae; ecological observations confirm this suggestion. The competition of algae for available nitrogen ions is a factor in natural conditions with different algal densities. In average lakes magnesium and potassium never limit the development of Scenedesmus quadricauda. Melosira islandica ssp helvetica prefers low temperatures; Ankistrodesmus falcatus higher temperatures. (Jones-Wisconsin)
W70-05409

RESERVOIR AUFWUCHS ON INUNDATED TREES,
Wisconsin State Univ., La Crosse. Dept. of Biology.
Thomas O. Claflin.
Transactions of the American Microscopical Society, Vol 87, No 1, p 97-104, 1968. 4 fig, 6 ref.

Descriptors: *Periphyton, *Reservoirs, Biomass, Flow, Water level fluctuation, Midges, Missouri River, Benthic fauna, Standing crop.
Identifiers: *Aufwuchs, Tendipedidae, Lewis and Clark Lake (S D-Neb), Lake Francis Case (S D), Midge larvae, Macrofauna.

Periphyton standing crop in Lewis and Clark Lake Reservoir, bordered by South Dakota-Nebraska, was greatest in May of 1964 and 1965, decreased

rapidly in June and July, then increased slightly in August and fell to low levels during periods of ice cover. Cell counts varied from more than 10 million cells/square centimeter of substrate in May to less than 100 thousand cells during ice cover. Standing crops in Lake Francis Case (South Dakota) reached later peaks due to more extreme water level fluctuations; maxima were observed in July. Tendepid larvae and pupae were most numerous groups associated with periphyton, reaching densities of 10,500 larvae and 4800 pupae per square meter of substrate. Standing crops of periphyton were much greater in Lewis and Clark Lake as based on total pigment analysis. Water level fluctuations in Lake Francis Case will probably preculde estiblishment of a vigorous periphyton community. (Voigtlander-Wisconsin)
W70-05410

NUTRIENT REMOVAL A UNIVERSAL REQUIREMENT,
Roger Davies.
Water and Pollution Control, p 28-30, January 1970. 1 fig.

Descriptors: *Nutrients, International Joint Commission, Lake Erie, Lake Ontario, Water pollution, Eutrophication, St Lawrence River, Oligotrophy, Turbidity, Productivity, Phytoplankton, Phosphorus, Nitrogen, Detergents, Industrial wastes, Municipal wastes, Retention, Sedimentation, Cyanophyta, Nitrogen fixation, Sewage treatment, Effluents, Drainage, Agricultural watersheds, Coliforms, Michigan, Ohio, New York, Storm drains, Viruses, Herbicides, Pesticides, Oil wastes, Gasoline, Drilling, Cost analysis.
Identifiers: *Removal, *Requirement, Mesotrophic, Canada, Detroit (Mich), Toledo (Ohio), Cleveland (Ohio), Buffalo (N Y), Niagara River (N Y), Oshawa (Canada), Standby equipment, Public.

This review of the International Joint Commission findings on pollution of Lakes Erie and Ontario and the St Lawrence River international section recommends complete replacement of phosphorus compounds in detergents and phosphorus reduction in municipal and industrial wastes with nitrogen reduction to follow. Partial replacement of phosphates in detergents is possible with no reduction in cleansing efficiency. An environmentally harmless substitute for full replacement of phosphates might be found. If phosphates were replaced in detergents, removal of 80% of remaining phosphorus at sewage treatment plants would reduce the concentration to 0.6 milligrams/liter. Further reductions in lakes are possible by preventing land drainage. Anti-pollution recommendations include: standby equipment to take over during breakdowns, inadequate performance, or overflows; separation of storm and sanitary sewage collection systems; avoidance of bypassing untreated wastes; intensification of viral research; requirement that organizations, planning thermal powerplants, submit plans to pollution control agencies; banning unconfined open lake dumping; implementation of herbicides and pesticides controls; recognition that oil and gas drilling are potential pollution sources; maintenance of adequate water quality monitoring. Success of the proposals depends upon willingness of the public to pay increased control costs. (Jones-Wisconsin)
W70-05412

THE AGING GREAT LAKES,
Charles F. Powers, and Andrew Robertson.
Scientific American, Vol 215, No 5, p 94-100, 102, 104, 1966. 8 fig.

Descriptors: *Eutrophication, *Great Lakes, *Lake Erie, Lake Huron, Fish, Fish populations, Bass, Herring, Walleye, Pikes, Lampreys, Carp, Trout, Commercial fishing, Perches, Industrial wastes, Wastes.
Identifiers: Detroit River, Cattaraugus Creek (N Y), Alewife, Suckers.

A general physical and geographical look at the Great Lakes together with some ecological changes that have occurred because of man's activities are presented. Natural aging aspects of the Lakes versus accelerated aging (eutrophication) are compared. One of the first instances of man's catastrophic effects on the natural resources followed the building of the Welland Canal, which allowed the sea lamprey and alewife to penetrate around Niagara Falls into the inner lakes. By the 1950's the alewife had killed off nearly all the lake trout and burbot in Lakes Huron, Michigan and Superior. The alewife has become prominent and threatens to change the ecological balance by feeding on the eggs of more desirable species. The coho salmon experiment in Lakes Michigan and Superior, to reduce the alewife population is briefly discussed. Ecological alterations that will occur as the result of pollution will be more profound. Industrial and municipal pollutants that are discharged into Lake Erie and their effect on commercial fishing are drastic. Between 1956 and 1965 catches of blue pike, walleye, lake herring, whitefish, and sauger declined while catches of undesirable species rose. (Haskins-Wisconsin)
W70-05415

THE PHYTOPLANKTON OF SOME IRISH LOUGHS AND AN ASSESSMENT OF THEIR TROPHIC STATUS,
Bristol Univ. (England). Dept. of Botany.
F. E. Round, and A. J. Brook.
Proceedings of the Royal Irish Academy, Vol 60, Sect B, p 167-191, 1959. 8 fig, 8 tab, 14 ref.

Descriptors: *Lakes, *Phytoplankton, *Littoral, Trophic level, Drainage, Eutrophication, Distribution, Sampling.
Identifiers: Bacillariophyceae, Chrysophyceae, Chrysospherinae, Cyanophyceae, Desmidae, Nygaard's compound index, Irish loughs, Morphological deviation, Ireland.

Phytoplankton was collected in early September with a 180-mesh/inch net from the margins of 26 loughs. Effort was made to avoid contamination of samples with benthic algae, The water basins were classified into oligotrophic, mesotrophic, and eutrophic on the basis of drainage influence and Nygaard's compound index. A general record of the distribution of taxa was supplemented by calculation of the phytoplankton quotients, ranging from 0.19 for oligotrophic to 21.0 for eutrophic basins. The results indicated a predominance of Desmids in oligotrophic loughs and Chlorococcales in eutrophic waters. Myxophyceae and Centric diatoms exhibited pronounced tropic preferences and may serve as indicators of eutrophication status. A comprehensive description of taxonomic contents of investigated basins is provided, as well as deviational forms of some organisms. (Wilde-Wisconsin)
W70-05416

PHOSPHATE FERTILIZATION OF PONDS,
Alabama Agricultural Experiment Station, Auburn.
H. S. Swingle, B. C. Gooch, and H. R. Rabanal.
Proceedings of the 17th Annual Conference, Southeastern Association of Game and Fish Commissioners, held at Hot Springs, Arkansas, September 29-October 2, p 213-218, 1963. 1 tab, 14 ref.

Descriptors: *Ponds, *Fertilization, *Phosphate, Fish, Plankton, Aquatic weed control, Insect control, Mosquitos, Algal control, Bass, Carp, Catfishes, Nitrogen, Potassium.
Identifiers: Phosphate fertilizers, Bluegills, Microcystis scums, Pithiophora algae.

Reinforcement of phosphate fertilization of fish ponds with nitrogen and potassium produced no significant increase in the biomass of plankton or fish yield. In ponds previously treated with 8-8-2 fertilizer, Microcystis scums continued to be a problem even when fertilization was limited to phosphates. In some instances, application of phosphate fertilizers alone delayed response for 30 to 60 days and permitted the growth of Pithophora algae. (Wilde-Wisconsin)
W70-05417

STANDING CROPS OF DISSOLVED ORGANIC MATTER, PLANKTON, AND SESTON IN A NEW AND AN OLD OZARK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
Richard L. Applegate, and James W. Mullan.
Reservoir Fishery Resources Symposium, Athens, Georgia, April 5-7, p 517-530, 1967. 8 fig, 5 tab, 14 ref.

Descriptors: *Standing crop, *Plankton, *Organic matter, *Reservoirs, Arkansas, Missouri, Seston, Phytoplankton, Zooplankton, Daphnia, Succession, Decomposing organic matter.
Identifiers: Nannoseston, Beaver Reservoir (Ark-Mo), Bull Shoals Reservoir (Ark-Mo), Daphnia galeata mendotae, White River (Ark-Mo).

Standing crops of dissolved organic matter, plankton and seston were compared for 12-15 year old Bull Shoals Reservoir and newly-impounded Beaver Reservoir on the White River. Concentration of dissolved organic matter in Beaver has inclined downward since impoundment, from 7.2 to 5.0 milligram/liter (mean, 5.8); mean for Bull Shoals is 6.2 mg/l. Beaver showed greater ranges of nannoseston and net seston and a greater mean of nannoseston (1.24 vs 1.03 mg/l as compared with Bull Shoals, while Bull Shoals showed a greater mean concentration of net seston (44.4 vs 32.6 mg/l for Beaver). Diatoms dominated phytoplankton of both reservoirs. Blue-green algae were of secondary importance in Beaver, yellow-green algae occupied a secondary position in Bull Shoals. Seasonal estimates of zooplankton standing crop showed a unimodal curve for Bull Shoals and a bimodal curve for Beaver. Rapid species succession in phytoplankton and zooplankton is taking place in Beaver, with larger species replacing smaller species. Daphnia galeata mendotae has replaced smaller daphnids. Mean annual amounts of items studied did not differ significantly between reservoirs; differences related primarily to sequences of abundance. (Voigtlander-Wisconsin)
W70-05421

SOME ENVIRONMENTAL FACTORS INFLUENCING BENTHIC INVERTEBRATES IN TWO MISSOURI RIVER RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak.
Bruce C. Cowell, and Patrick L. Hudson.
Reservoir Fishery Resources Symposium, April 5-7, 1967, Athens, Georgia, p 541-555, Nov 1968. 4 fig, 4 tab, 10 ref.

Descriptors: *Benthic fauna, *Invertebrates, *Missouri River, *Reservoirs, Temperature, Dissolved oxygen, Periphyton, Water levels, Waves (Water), Depth, Population.
Identifiers: Substrate, Morphometry, Lewis and Clark Lake (S. Dak), Lake Francis Case (S. Dak), Hexagenia, Chironomid larvae.

A smaller, shallow reservoir on the Missouri River (Lewis and Clark Lake) was compared with larger, deeper Lake Francis Case to determine factors influencing benthic invertebrate populations. Temperature was the major factor in controlling life cycle duration of Hexagenia. Substrate type appeared limiting only in areas containing high percentages of sand. Hexagenia nymphs apparently migrate from deeper channel areas during periods of low oxygen concentration. Swift currents and heavy wave action produce substrate types unsuitable for Hexagenia and chironomids. Migration of Hexagenia nymphs is nocturnal and may be initiated by increasing temperature, water level fluctuation and population densities. Estimates of Hexagenia loss from Lewis and Clark Lake (mid-April to early July) amount to 170 million nymphs or

24.1 metric tons, about 10% of the spring standing crop. Similar estimates of total chironomids and ceratopogonids loss amounted to 20 metric tons. Benthic invertebrates appear on inundated trees and aquatic plants immediately after onset of periphyton growth; densities of benthic fauna in periphyton were significantly higher than for adjacent bottom areas. (Voigtlander-Wisconsin)
W70-05422

CHEMICAL CHARACTERISTICS OF SOUTH-CENTRAL LAKE HURON,
Bureau of Commercial Fisheries, Ann Arbor, Mich.
Herbert E. Allen.
Michigan Univ, Ann Arbor, Great Lakes Research Division, Publication No 11, p 45-53, 1964. 2 fig, 2 tab, 8 ref.

Descriptors: *Lake Huron, *Chemical properties, *Chemical analysis, Temperature, Hydrogen ion concentration, Conductivity, Calcium, Potassium, Sodium, Chlorides, Sulfates, Silica, Currents (Water).
Identifiers: Saginaw Bay.

Water samples for chemical analysis were collected from south-central Lake Huron between June and November, 1956. Data is based on 233 samples taken from stations at the mouth of Saginaw Bay and along a transect from Harbor Beach, Michigan, to Goderich, Ontario. Median values were chosen to represent the usual composition of the lake since average values were influenced by water outflow from Saginaw Bay. Medium values for the eight cruises were: sodium, 2.54 ppm; potassium, 0.85 ppm; calcium, 26.7 ppm; chloride, 5.9 ppm; sulfate, 13 ppm; silica 1.9 ppm; and conductivity 174 micro-ohms at 18C. Median values for all chemicals, with the exception of silica, were higher at the surface than in subsurface samples although differences were slight. Above median concentrations were obtained most frequently for sodium, calcium, chloride, and conductivity, attributable to Saginaw Bay water outflow and substantiated by current patterns evaluated by drift bottles released during three cruises. Results, with the exception of calcium (2-3 ppm higher) and silica, agreed with previously published data. The reason for differences in calcium results were unknown. Seasonal and depth differences in silica concentrations were attributed to its incorporation by diatoms. (Haskins-Wisconsin)
W70-05423

CELL METHOD FOR COMPUTING LAKE CIRCULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
James A. Liggett.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7152, p 725-743, March 1970. 19 p, 13 fig, 4 ref, append.

Descriptors. *Lakes, *Water circulation, *Mathematical models, *Computer programs, Flow, Hydraulics, Coriolis force, Path of pollutants, Winds, Turbulent flow, Topography, Eddies, Limnology.
Identifiers: Eddy viscosity, Lake circulation.

The equations of fluid motion are solved using finite differences for the three-dimensional, wind-driven circulation in a homogeneous lake of arbitrary bottom topography. The method allows arbitrary choices for the wind stress, the horizontal and vertical eddy viscosities, and the distribution of vertical eddy viscosity. For the examples investigated the nonlinear terms of the equations contributed little or nothing, indicating that lake circulation is well described by linear equations. The magnitudes of the horizontal and vertical eddy viscosities have a strong effect on the current velocity but only a minor effect on the circulation patterns. The distribution of the vertical eddy viscosity appears to play a minor role in the circulation pattern. Sample calculations indicate that some combinations of horizontal eddy viscosity, vertical eddy viscosity, and distribution of vertical eddy viscosity are nearly equivalent in that these combinations produce similar response curves, similar current velocities and circulation patterns having small differences. (Knapp-USGS)
W70-05482

2I. Water in Plants

PHYSIOLOGICAL RESPONSE OF PLANTS TO SALINITY AND HUMIDITY,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
James W. O'Leary, and James J. Riley.
Available from the Clearinghouse as PB-190 484, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, (1970). 13 p, 3 tab, 1 fig. A-016-ARIZ.

Descriptors: *Plant physiology, *Salt tolerance, *Saline water, Plant growth.

Red kidney bean (Phaseolus vulgaris L.) plants were grown in nutrient solutions in conventional greenhouses (relative humidity 40-50%) and closed system greenhouses (relative humidity 85-95%). Some of the solutions were salinized with 5600 ppm NaCl. During the winter the beneficial effect of high humidity on bean yield was excellent, the salt-treated plants yielding almost four times the dry weight of beans as the salt-treated plants in the conventional greenhouses. In fact, the yield from the salt-treated plants in the high humidity was about 90% of the yield from the control plants in the conventional greenhouse. It is concluded that there is considerable promise of being able to use brackish water for a highly salt sensitive crop such as red kidney beans when they are grown in a high humidity environment. For more salt tolerant plants, the potential should be even greater.
W70-05119

AQUATIC WEEDS,
Wisconsin Univ., Madison; and Agricultural Research Service, Fort Lauderdale, Fla.
L. G. Holm, L. W. Weldon, and R. D. Blackburn.
Science, Vol 166, No 3906, p 699-709, Nov, 1969. 11 p, 10 fig, 29 ref.

Descriptors: *Aquatic environment, Aquatic plants, Environment, Lakes, *Aquatic weed control, *Aquatic weeds, *Ecology, *Environmental effects, Limnology, Biology, Biocontrol, Herbicides, Mechanical control, Streams, Rivers, Reservoirs, Water pollution, Water quality, Phreatophytes, Water resources, Water hyacinth, Bibliographies.
Identifiers: Submersed weeds, Emersed weeds, Floating weeds.

In converting virgin land to intensified farming and altering watercourses with dams and reservoirs, the balance of nature is upset and new species of weeds, rodents, insects, and diseases appear where they did not exist before. Several explosions of aquatic weeds in the great rivers and lakes of the warm regions of the world have forced us to recognize the power of such infestations. Aquatic weeds destroy fisheries, obstruct waterflow, prevent recreation, increase evaporation, stop navigation, cause large losses of water through increased evaporation and transpiration, depress real estate values, present health hazards, and interfere with hydroelectric and irrigation schemes. The rapid growth of weed infestations has been spectacular and frightening, and has made us aware that something is wrong. Problems produced by infestations of water hyacinth, salvina, water lettuce, submersed weeds, emersed weeds, phreatophytes, and floating island weeds are discussed. Chemical, biological, and mechanical methods for aquatic weed control are described. Streams and lakes are not self-cleansing bodies; the tools for restoration can be found in combinations of chemical, biological, and mechanical control. (USBR)
W70-05215

SPECIES-SOIL RELATIONSHIPS ON THE GREAT SALT PLAINS OF NORTHERN OKLAHOMA,
Ohio Univ., Athens. Dept. of Botany.
Irwin A. Ungar.
American Midland Naturalist, Vol 80, No 2, p 392-406, October 1968. 3 fig, 7 tab, 22 ref.

Descriptors: *Halophytes, *Salt tolerance, *Saline soils, *Salinity, *Vegetation, Oklahoma, Rainfall, Soil moisture, Soil texture, Chlorides, Hydrogen ion concentration, Conductivity, Soil-water-plant relationships, Sands, Seeds, Dunes, Germination, Organic matter, Plant communities.
Identifiers: *Great Salt Plains, *Indicator species, Salt pans.

The Great Salt Plains of Alfalfa County, Oklahoma, is a 32,000-acre area of highly saline soils. Vegetation of the region was analyzed quantitatively in an attempt to discover the salt tolerance of species and the effects of salinity on their density and frequency. The analyzed species appear to be indicative of varying degrees of soil salinity and can be used as indicators. While the lower limit of soil salinity for halophytic vegetation is within the range in which nonhalophytes survive, it is toward the upper limit of salt tolerance that the halophytes invade the Salt Plains. Interrelationships of seasonal rainfall, soil moisture, salinity, and conductivity of soil solutions are shown. (Carr-Arizona)
W70-05287

STRUCTURE AND ASSOCIATION IN THE MULGA (ACACIA ANEURA) LANDS OF SOUTH-WESTERN QUEENSLAND,
Charleville Pastoral Lab. (Australia).
W. H. Burrows, and I. F. Beale.
Australian Journal of Botany, Vol 17, No 3, p 539-552, December 1969. 2 fig, 4 tab, 16 ref, 1 append.

Descriptors: *Semiarid climates, *Biological communities, *Ecological distribution, *Data collections, *Desert plants, Droughts, Moisture stress, Arid lands, Analytical techniques, Environmental gradient, Biogeography, On-site data collections, Distribution patterns, Vegetation effects, Surveys.
Identifiers: *Australia, *Queensland, *Microtopography, *Mulga, Association analysis, Mosaics.

The primary purpose of this botanical survey was to record the occurrence of species and to interpret species and community relationships in a long-range study of vegetation change in semiarid southwestern Queensland. Woody vegetation was recorded along two permanently located 20-mile belt transects and the data were interpreted by association analysis. Several site groups were recognized, their location depending on their elevation between the mesic flats and the xeric ridges. The vegetation at both sites represents small mosaics. At the Tobermory site the density of young mulga is not considered adequate for future drought reserves. The survey revealed that in this semiarid environment very large-scale vegetation groups have a very small-scale structure which is based on microtopography. The results of this study should be useful in a fuller utilization of arid zone resources in Queensland. (Carr-Arizona)
W70-05289

DESIGN FEATURES OF INTACT LEAF THERMOCOUPLE PSYCHROMETERS FOR MEASURING WATER POTENTIAL,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; Agricultural Research Service, Riverside, Calif. Salinity Lab.; and Army Electronics Command, Fort Huachuca, Ariz. Research Div.
G. J. Hoffman, and W. N. Herkelrath.
American Society of Agricultural Engineers, Transactions, Vol 11, No 5, p 631-634, September-October 1968. 4 fig, 2 tab, 11 ref.

Descriptors: *Soil-water-plant relationships, *Hygrometry, *Leaves, *Instrumentation, *Measurement, Isotherms, Air temperature, Sealants, Calibrations.

Identifiers: *Water potential, *Thermocouple psychrometers.

Although it would be preferable to measure the water potential of components of the plant-soil system under field conditions, such measurements are usually made on detached leaf samples under isothermal conditions. Now a miniature thermocouple psychrometer has been developed to measure water potential of intact leaves. While designed to minimize interference with leaf metabolic processes, miniaturization of the probe did not affect the water potential readings. The study also revealed that the best sealant with which to attach the probe to leaves was a silver-impregnated, water-based conductive paint. (Carr-Arizona)
W70-05294

TRANSPIRATION INTENSITY AS RELATED TO VEGETATION ZONATION IN THE WHITE MOUNTAINS OF CALIFORNIA,
California Univ., Los Angeles. Dept. of Botanical Sciences.
For primary bibliographic entry see Field 02D.
W70-05299

THE MOLECULAR NATURE OF ORGANIC MATTER IN LAKES AND OCEANS, WITH LESSER REFERENCE TO SEWAGE AND TERRESTRIAL SOILS,
Queen's Univ., Kingston (Ontario).
J. R. Vallentyne.
Journal Fisheries Research Board of Canada, Vol 14, No 1, p 33-82, 1957. 3 tab, 343 ref.

Descriptors: *Molecular structure, Water structure, Soil chemistry, Organic matter, Soil properties, Sewage, Ions, Analysis, Distillation, Lakes, Oceans, Soils, Chromatography, Activated sludge.
Identifiers: *Toxic plankton, Microcystis, Gleotrichia, Gonyaulax, Prymnesium.

The essential, often overlooked detail of studies related to biochemical ecology is that organisms respond to the molecular configuration of atoms rather than atoms themselves. Recent developments of chromatographic analyses permit now identification of minute amounts of specific organic compounds even when they are present in complex mixtures. This report is concerned with isolation and identification of organic compounds found in seston, humus-enriched water, sediments of lakes and oceans, soils, sewage, and activated sludge. The composition of these media includes carbohydrates, proteinaceous and miscellaneous nitrogen compounds, fats, waxes, alcohols, aldehydes, lignins, chlorophyll, carotenoids, sterids, non-carotenoid hydrocarbons, and vitamins, enzymes, excretions of toxic plankton, and partially characterized compounds. The number of adequately identified compounds in each of the sources is: seston - 45, water - 15, sewage - 14, aquatic sediments - 62, soils - 76. Proximate analyses of organic matter and the determination of 'humins,' 'ulmins,' 'crenic,' 'apocrenic' acids, and the like enigmatic fractions of different solubility are of questionable significance. (Wilde-Wisconsin)
W70-05395

2J. Erosion and Sedimentation

RIVER CHANNEL PATTERNS,
Central Water and Power Research Station, Poona (India).
For primary bibliographic entry see Field 02E.
W70-05065

CORRELATION BETWEEN THE QUANTITY OF BED LOAD AND SUSPENDED LOAD IN RIVERS,
Polish Hydrological Service, Warsaw.
Walenty Jarocki.
Available from Clearinghouse as TT-66-57039, for $3.00 in paper copy, $0.65 in microfiche. Published for Dept of Interior and Nat Sci Found, Washington, D C, by Central Institute for Sci, Tech, and Econ Inf, Warsaw, Poland. Archiwum Hydrotechniki, Vol 14, No 4, pp 535-570, 1967. 36 p, 13 fig, 14 tab, 21 ref.

Descriptors: *Bed load, *Suspended load, *Sediment transport, *Rivers, Sedimentology, Statistical methods, Sampling, Hydraulics, Streamflow, Suspension, Sediment discharge, Sediment distribution, Particle size, Discharge (Water).
Identifiers: Poland.

The radio of bed load to suspended load in rivers was studied by extrapolating mean annual load values from mean monthly and annual water-discharge to sediment-discharge relations, by empirical formulas, and by suspended load sampling programs in Polish rivers. It was found that bed load is always smaller than suspended load at any one place and time. The correlation between quantity of load and the ratio of bed to suspended load ($K = W/U$) is good, with a mean value of 0.022 for K. The value of K tends to decrease as the discharge (Q) increases. The effects of velocity, water level slope, and bed load particle size are difficult to evaluate. (Knapp-USGS)
W70-05082

INFLUENCES OF NORWEGIAN SEA OVERFLOW WATER ON SEDIMENTATION IN THE NORTHERN NORTH ATLANTIC AND LABRADOR SEA,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
E. J. W. Jones, M. Ewing, J. I. Ewing, and S. L. Eittreim.
Journal of Geophysical Research, Vol 75, No 9, p 1655-1680, March 20, 1970. 26 p, 18 fig, 64 ref. ONR Contract N00014-67-A-018-0004.

Descriptors: *Sedimentation, *Oceans, *Oceanography, Seismic studies, Sounding, Hydrography, Bottom sediments, Ocean currents, Density currents, Turbidity currents, Ocean circulation.
Identifiers: Labrador basin, Norwegian Sea.

Reflection profiles and hydrographic data indicate that sedimentation in parts of the northernmost Atlantic and in the Labrador basin has been largely governed by the movement of bottom water derived from the Norwegian Sea. Seismic profiles from the Labrador basin reveal a well-defined body of thick sediments trending NNW on a portion of the continental rise of southern Greeland where turbidity currents cannot reach. The thick sediments lie in a region in which the flow of deep water is weak and in which rapid deposition from sediment-laden bottom waters is allowed. Appreciably stronger bottom currents associated with the counterclockwise circulation of dense water derived from the Norwegian Sea appear to have greatly inhibited deposition of pelagic material in the area surrounding the sediment body. Sedimentation under the influence of bottom currents in this region, in the Rockall area, and on the Blake-Bahama outer ridge took place throughout a large part of Tertiary time but did not occur in the Upper Cretaceous. This is attributed to a major alteration in the circulation pattern of the North Atlantic caused by continental drift, polar wandering, and climatic deterioration between late Cretaceous and late Eocene times. (Knapp-USGS)
W70-05131

SETTLING VELOCITIES AND VERTICAL DIFFUSION OF PARTICLES IN TURBULENT WATER.
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
Stephen P. Murray.
Journal of Geophysical Research, Vol 75, No 9, p 1647-1654, March 20, 1970. 8 p, 7 fig, 1 tab, 16 ref. ONR Contract Nonr 1575 (03), NR 388002.

Descriptors: *Settling velocity, *Turbulent flow, Sands, Turbulence, Particle size, Particle shape, Sedimentation, Sedimentology, Model studies, Mathematical studies, Laboratory tests, Diffusion, Sampling, Sedimentation rates, Path of pollutants.
Identifiers: Particle diffusion.

A turbulent flow field that permits study of the kinematics of individual suspended particles was produced in the laboratory. The behavior in the vertical direction of particles 2 mm in diameter that have still-water terminal settling velocities ranging up to 4.0 cm/sec was observed. The particle velocity frequency distributions are approximately Gaussian, and their root-mean-square values prove to be nearly independent of terminal fall velocity. In the majority of cases, particle diffusivity is greater than fluid diffusivity. The average velocity of fall determined by experiment in the various turbulent fields is reduced by as much as 30% below the corresponding still-water terminal fall velocity. A simple theoretical model predicts the fall velocity reduction due to a nonlinearity in the drag force. The model is then extrapolated to describe the behavior of quartz sand under field-scale turbulence conditions. It predicts the time and distance required for such sand to reach terminal fall velocity in still water. (Knapp-USGS)
W70-05133

FORMATION OF DUNES AND ANTIDUNES IN OPEN CHANNELS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Taizo Hayashi.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7056, p 357-366, February 1970. 10p, 8 fig, 4 ref, append.

Descriptors: *Sediment transport, *Open channel flow, *Bed load, *Dunes, *Sand waves, Model studies, Mathematical models, Hydraulic models, Sedimentary structures, Scour, Channel morphology, Stream erosion.
Identifiers: Antidunes.

The formation of dunes and antidunes on the erodible bed of an open channel is studied analytically as a problem of stability of the erodible bed. The phase lag existing between the local sediment-transport rate and the local velocity on the bed plays an essential role in the formation of the sand waves. A physical model for the transport of sediment over a wavy bed is presented and a quantitative explanation of this phase lag is developed. The regions of occurrence of dunes, flat beds, and antidunes are examined in detail. Predicted regions of occurrence of those bed configurations are compared with experimental results previously summarized by Kennedy, the comparison showing a good agreement. (Knapp-USGS)
W70-05144

WAVE-INDUCED PRESSURES IN BEDS OF SAND,
Cambridge Univ. (England). Dept. of Engineering.
John F. A. Sleath.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7057, p 367-378, February 1970. 12 p, 5 fig, 1 tab, 5 ref, append.

Descriptors: *Water pressure, *Pore pressure, *Waves (Water), *Sands, Porous media, Permeability, Porosity, Anisotropy, Beaches, Hydraulics, Hydraulic models.
Identifiers: Pore pressure fluctuations.

Measurements of the variation of the fluctuating component of pressure have been made in two different beds of sand in a wave channel. The sand was laid from an overhead hopper, and it is shown that the stratification of the bed produced by this method causes the permeability to be different in the vertical and horizontal directions. It is suggested that a similar situation exists in the sea bed. Analytical relationships for the pressure and velocity distributions in such a situation are developed, and the agreement between theory and

experiment is found to be quite good. (Knapp-USGS)
W70-05145

DEPTH-INTEGRATING AND DIP SAMPLERS,
Agricultural Research Service, Riesel, Tex. Southern Plains Branch.
For primary bibliographic entry see Field 07B.
W70-05149

EFFECT OF FLUME WIDTH ON BED-FORM CHARACTERISTICS,
Hydraulics Research Station. Wallingford (England).
Maurice J. Crickmore.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7077, p 473-496, February 1970. 24 p, 9 fig, 4 tab, 22 ref, append.

Descriptors: *Bed load, *Sedimentary structures, *Channel morphology, *Width, Sand waves, Dunes, Scour, Stream erosion, Sediment transport, Hydraulics, Sands, Waves (Water), Flow resistance, Roughness (Hydraulic), Model studies, Flumes, Hydraulic models.
Identifiers: Bed-form shapes, flume studies.

The dimensions of bed-forms developed in laboratory channels are found to be a function of channel width. A 10% to 30% reduction is observed in the size of irregularities displayed by a self-formed bed of 0.6 mm diameter sand in a channel of 1.5 ft width, compared to that in a 5.0 ft wide channel, under closely similar water and sediment discharge conditions. Emphasis is placed on the need to standardize parameters for the dimensional description of bed-form profile, and the adoption of significant form height and the average distance between alternate zero-crossings is advised. The distribution of bed elevations conforms reasonably well with accepted theoretical distributions for water waves provided allowance is made for the greater spectral width values that characterize the bed-form profiles. Because sediment movement occurs as surface creep in this case, the transport, calculated from bed-form celerity and a form height parameter proposed by Mercer, is in close agreement with the measured total transport. (Knapp-USGS)
W70-05150

CLOGGING OF POROUS COLUMN OF SPHERES BY SEDIMENT,
California Univ., Berkeley. Coll. of Engineering.
Ramaswamy Sakthivadivel, and H. A. Einstein.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7075, pp 461-472, February 1970. 12 p, 6 fig, 5 ref, append. NSF Grant No GK-0591.

Descriptors: *Flow, *Porous media, *Deposition (Sediments), Sediment transport, Hydraulics, Sediment control, Filtration, Particle shape, Particle size, Porosity, Permeability, Interstices, Pores, Seepage, Voids.
Identifiers: Filter clogging.

When a sediment suspension moves downward at a constant laminar flow through a vertical porous column packed regularly with uniform spheres and having critical pores which permit passage of spheres smaller than 1/7-diam of the matrix grain, sediment deposition takes place by a characteristic mechanism known as 'bridging.' The critical parameter which controls the clogging of the matrix is the ratio of the pore size of the matrix to the sediment size. Sediment with diameters equal to or greater than half the critical pore diameter of the matrix will deposit and, in time, totally clog the matrix preventing further motion of sediment particles through the matrix. Sediment with diameters less than half the critical pore diameter will deposit only in the 'dead space' of the matrix by the straining mechanism. Considering sediment deposition in a vertical porous column as a stochastic process of pure birth, the time and space variation of sediment accumulation in the column is described by a second-order partial differential equation which has a closed solution. The hydraulic resistance of a clogging matrix is represented by an equation similar to Kozeny-Carman equation for head loss in flow through porous media and was verified experimentally. (Knapp-USGS)
W70-05151

PARTICLE SIZE OF RIVER SEDIMENTS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering; and Clyde River Purification Board, East Kilbride (Scotland).
George Fleming, and Thomas Poodle.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7068, p 431-439, February 1970. 9p, 10 fig, 9 ref.

Descriptors: *Sediment transport, *Discharge (Water), *Particle size, Sediment load, Sediments, Suspended load, Bed load, Rivers, Sedimentology.
Identifiers: River sediments, Scotland.

The relationships between particle size of river sediments and the variation in stream discharge were studied. The particle size of suspended and bed sediments remains relatively constant with variation in stream discharge. This condition was found from the analysis of results at four river sections on three rivers in Scotland and was also corroborated by results from research in the United States. The availability of material for transport by streams rather than purely hydraulic considerations may explain these findings. (Knapp-USGS)
W70-05153

ERODIBILITY OF CHANNELS WITH COHESIVE BOUNDARY,
State Univ. of New York, Buffalo. Dept. of Civil Engineering.
Emmanuel Partheniades, and Robert E. Paaswell.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7156, p 755-771, March 1970. 17 p, 5 fig, 28 ref, append.

Descriptors: *Sediment transport, *Scour, *Reviews, *Model studies, *Deposition (Sediments), Sedimentation, Hydraulics, Open channel flow, Sediment load, Stream erosion, Hydraulic models, Soil erosion, Canals, Open channels, Soil strength.
Identifiers: *Channel erodibility.

Results of laboratory investigations on the erodibility of cohesive soils by water were critically reviewed, summarized and compared with similar field results and with older empirical information. There is strong experimental evidence, substantiated by physical reasoning, that the bed shear stress strongly controls both the erosion and the deposition of cohesive sediments. The net attractive physicochemical interparticle forces in the soil provide the main resistance to erosion. For low values the soil shear strength itself does not have any measurable effect on soil erodibility, while for medium to high strength clays, the resistance to erosion seems in general to increase with the macroscopic strength. Under certain conditions erosion may stop completely after some scouring. The depth of this scouring and the final bed roughness increase with increasing shear stress and decreasing shear strength of the bed. A mechanistic model about the interaction between the surface of the bed and the flow is described which explains the observed phenomena. A set of tentative rules is suggested for design of stable channels with cohesive boundaries. (Knapp-USGS)
W70-05159

INITIAL INSTABILITY OF FINE BED SAND,
University Coll., London (England). Dept. of Civil Engineering.
Anthony J. Grass.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7139, p 619-632, March 1970. 14 p, 5 fig, 2 tab, 15 ref, append.

Descriptors: *Sediment transport, *Bed load, Open channel flow, Hydraulics, Turbulent flow, Turbulence, Shear stress, Sand waves, Dunes, Roughness (Hydraulic), Probability, Sands, Sediments, Sedimentology, Stochastic processes, Model studies, Hydraulic models.
Identifiers: Sand bed instability.

The initial entrainment characteristics of fine bed sand are defined in terms of the measured distributions of critical instantaneous bed shear stress associated with the observed movement of individual surface grains. Critical flow conditions are predicted by equating the lower extremes on the critical shear stress distributions to the upper extremes in the distribution of instantaneous bed shear stress. The method is applied to the case of two-dimensional channel flow over a flat bed and yields sufficiently consistent results to suggest an extension to Shields' curve for small grain Reynolds numbers. The detailed experimental observations illustrate the important role played by bed region turbulence. (Knapp-USGS)
W70-05161

THE MODERN SEDIMENTS OF PAMLICO SOUND, NORTH CAROLINA,
Delaware State Geological Survey, Newark; and North Carolina Univ., Chapel Hill. Dept. of Geology.
T. E. Pickett, and R. L. Ingram.
Southeastern Geology, Vol 11, No 2, p 53-83, 1969. 31 p, 13 fig, 1 tab, 25 ref.

Descriptors: *Sedimentation, *Sediments, *Bays, *North Carolina, Lagoons, Beaches, Bottom sediments, Sands, Provenance, Sediment transport, Sedimentology.
Identifiers: Pamlico Sound (NC), Lithology.

Pamlico Sound, North Carolina can be divided into 11 environments of deposition, each recognized by characteristic lithology: barrier island, central basin, cross lagoon shoal, finger shoal, inlet, lagoonal beach, lagoon near narrows, lagoon near river mouth, mainland marsh, marginal lagoon, protected mainland embayment. Water depth, sediment source, and wave and current action are the dominant factors controlling sediment distribution. (Knapp-USGS)
W70-05174

COMPARISON OF METHODS OF CALCULATING PARTICLE SIZE FROM HINDERED SETTLING RESULTS AND ITS APPLICATION TO INORGANIC OXYSALT PRECIPITATES,
Salford Univ. (England). Dept. of Chemistry; and Stand Grammar School, Whitefield (England).
D. Dollimore, and G. B. McBride.
Analyst, Vol 94, No 1122, p 760-767, September 1969. 8 p, 5 fig, 5 tab, 10 ref.

Descriptors: *Sedimentation, *Chemical precipitation, *Particle size, *Settling velocity, Suspension, Aqueous solutions, Water chemistry, Chemical reactions, Calcium carbonate, Flocculation.
Identifiers: Particle size analysis.

The methods of calculating particle size from the results of hindered settling determinations are critically compared and a simple and rapid method of determining particle size is given. In the precipitation of basic copper carbonate the results of hindered settling measurements are compared with those from the use of a Coulter counter and from wet sieving. An analysis was made of the conditions affecting calcium carbonate particle size in precipitation processes and the mechanism of precipitation from saturated solutions. Information was obtained about the amount of immobile liquid carried down by the precipitate as it settles. The mechanism of flocculation is explained on the basis of hydrogen bonding between the flocculating agent and hydroxyl groups on the surface. A comparison of the particle size and the settled volume after precipitation can, for particular samples, be correlated. When a direct relationship occurs this

enables information to be obtained about the attractive forces between the particles and the variation of this force with the precipitation conditions. (Knapp-USGS)
W70-05179

ON THE EFFECTS OF SUSPENDED SEDIMENTS TO THE BED ROUGHNESS,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
Hideo Kikkawa, Hiroyoshi Shi-igai, and Shoji Fukuoka.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A7, p 49-56, 1967. 8 p, 6 fig, 9 ref.

Descriptors: *Roughness (Hydraulic), *Suspended load, *Turbulent flow, *Open channel flow, Sediment transport, Model studies, Mathematical models, Hydraulic models, Bed load.
Identifiers: Suspended load-hydraulic roughness relations.

To express the roughness of the flow precisely and systematically for the various bed configurations in open channels with movable beds, the logarithmic velocity formula is used for mean velocity. If the effect on roughness caused by suspended sediment concentration is removed by Karman's constant variation, the relative (equivalent) roughness may be expressed definitely by the hydraulic characteristics. (Knapp-USGS)
W70-05188

MOVABLE BED MODEL FOR ALLUVIAL CHANNEL STUDIES,
Corps of Engineers, Omaha, Nebr.
Alfred S. Harrison, and Warren J. Mellema.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A25, p 202-209, 1967. 8 p, 6 fig, 5 ref.

Descriptors: *Model studies, *Missouri River, *Hydraulic models, Sediment transport, Navigation, Alluvial channels, Hydraulic similitude, Discharge (Water), Bed load, Sedimentation, Channel morphology.
Identifiers: Missouri River models, Corps of Engineers (US Army).

A movable bed model facility was developed for studying problems in the design and maintenance of the channel stabilization and navigation project on the Missouri River. The bed material is ground walnut shells (Specific Gravity 1.30) which is very similar to Missouri River sand in gradation, settling characteristics, and nature of bar and bank formations. Although similarity criteria have been developed for modeling alluvial channels, practical limitations force many distortions in similitude criteria. This makes the selection of scales for modeling stabilized river reaches a semiempirical process in which depth and discharge scales are adjusted until the model appears to reproduce the most important over-all channel characteristics in the prototype. Several practical constraints on the choice of scales are discussed. The selection of scales for modeling navigation channel problems in two Missouri River reaches is described. Techniques have been developed for measuring geometrical, hydraulic, and sedimentation characteristics in the model with reasonable precision. This permits studies of hydraulic resistance and sedimentation characteristics in alluvial channels and avoids the nonsimilarity to natural rivers imposed by the straight side walls in laboratory channels. Hydraulic resistance in the model is shown to fit the same relationship as natural river reaches on the Missouri and Mississippi Rivers. (Knapp-USGS)
W70-05192

BOTTOM SHEAR MEASUREMENT IN AN OPEN CHANNEL FLOW,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
T. Sitki Bursali.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A24, p 194-201, 1967. 8 p, 11 fig, 2 tab.

Descriptors: *Open channel flow, *Alluvial channels, *Channel morphology, Sand waves, Roughness (Hydraulic), Shear drag, Turbulent flow, Model studies, Hydraulic models, Shear stress.
Identifiers: Turkey.

Resistance to flow, as well as the bed load movement in an alluvial channel can be defined starting from the notion of shear velocity. Formulas are not valid in an alluvial channel if the bottom is covered with sand waves, dunes or antidunes. Theoretical computation of shear stress on a dune is nearly impossible because of the secondary currents and perturbations in the vicinity of the bottom. Whereas, a direct measurement apparatus would be able to inform us about the skin friction on any point of the dune as well as the total force exerted by the flow. For this purpose, a direct shear measurement apparatus has been realized. Preliminary experiments on smooth and rough bottoms have given satisfactory results. They are compared with the computed results and surface pitot tube measurements. (Knapp-USGS)
W70-05193

EXPERIMENTAL STUDY OF FLUME-BED ROUGHNESS,
Research Inst. for Water Resources Development, Budapest (Hungary).
Laszlo Rakoczi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A22, p 181-186, 1967. 6 p, 1 fig, 3 tab, 4 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Bed load, Sands, Gravels, Streamflow, Sediment transport, Discharge (Water), Sediment discharge, Sand waves, Model studies, Hydraulic models, Laboratory tests.
Identifiers: Hungary.

Laboratory experiments were carried out using four different sand and sand-gravel mixtures as bed material to determine the share of the total energy of flow required for sediment transport. The dune bed obtained by the first run was artificially fixed, then the original discharge was let again into the flume and the differences in the hydraulic parameters resulting from fixing of the dunes were determined. Thus, the total head loss of flow could be separated into three parts due to bed forms, grain size roughness, and transport of sediment. The results show the primary importance of the slopes, in comparison to depths or hydraulic radii in determining the sediment-transporting capacity. (Knapp-USGS)
W70-05194

THE EFFECT OF SAND RIPPLES ON THE INCREASE OF RIVER BED ROUGHNESS,
Hydraulic Research Inst., Prague (Czechoslovakia). Dept. of Hydraulics and Hydrology.
Jaroslav Martinec.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A21, p 172-180, 1967. 9 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Channel morphology, *Roughness (Hydraulic), *Alluvial channels, *Sand waves, Ripple marks, Turbulent flow, Bed load, Sediment transport, Mannings equation, Rivers.
Identifiers: Czechoslovakia, Loznice River.

As a contribution to the problem of sand ripples and their effect on the resistance to flow in alluvial channels, experimental data are presented which were obtained by repeated comparative measurements in a representative river reach. The increase of flow resistance was expressed as a function of the average height of roughness. A velocity formula containing the factor of relative roughness was used to calculate this function. The height of ripples increased with the growing discharge and caused a gradual increase of flow resistance expressed as the effective height of roughness. A deterioration of flow conditions was observed for higher discharges due to sediment transport or different shapes of ripples. The measured variation of the Manning coefficient n from 0.0165 to 0.034 indicates the importance of this problem. (Knapp-USGS)
W70-05195

OBSERVED FORMS OF BED ROUGHNESS IN AN UNSTABLE GRAVEL RIVER,
Research Council of Alberta, Edmonton.
For primary bibliographic entry see Field 02E.
W70-05196

DETERMINATION OF ROUGHNESS COEFFICIENTS FOR VERY IRREGULAR RIVERS WITH LARGE FLOODPLAINS,
Institute for Water Resources, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 02E.
W70-05197

COLUMBIA RIVER BED FORMS,
Washington Univ., Seattle. Dept. of Geology; and Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02E.
W70-05198

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
For primary bibliographic entry see Field 08B.
W70-05199

EFFECT OF BEDLOAD MOVEMENT ON THE ROUGHNESS COEFFICIENT VALUE,
Hydraulic Research Inst., Bratislava (Czechoslovakia).
Jan Vincent.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A20, p 162-171, 1967. 10 p, 7 fig, 2 tab, 5 ref.

Descriptors: *Roughness (Hydraulic), *Alluvial channels, *Sand waves, Turbulent flow, Channel morphology, Bed load, Sediment transport, Model studies, Hydraulic models.
Identifiers: Czechoslovakia.

The effect of bedload movement on the magnitude of the roughness coefficient is investigated on the basis of experimental results in a rectangular flume, 70 m long. Because of the effect of bedload movement in dunes the values of roughness coefficient substantially increased. On the basis of results obtained during the experimental research it was possible to derive empirical equations for the computation of roughness coefficient and bedload movement in the range investigated. The conditions for the initiation of spiral water movement and transverse discharge in a direct rectangular flume are presented in relation to hydraulic parameters. (Knapp-USGS)
W70-05200

ABOUT THE ROUGHNESS IN ALLUVIAL CHANNELS WITH COMPARATIVELY COARSE BED MATERIALS,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
L. Veiga da Cunha.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A10, p 76-84, 1967. 9 p, 4 fig, 7 ref.

Descriptors: *Roughness (Hydraulic), *Sediment transport, *Alluvial channels, *Rivers, Turbulent flow, Particle size, Bed load, Equations, Regime, Open channel flow, Flood plains, River training.
Identifiers: *Portugal, Mondego River.

The Mondego River flows through the central area of Portugal, having its origin in Serra da Estrela and its mouth in the Atlantic Ocean, near Figueira da Foz. Its catchment area is about 6700 sq km and its total length is 240 km. In its upper reach, about 200 km in length, the river has the characteristics of a mountain stream, flowing in a deep valley. In its last 40 km the river flows in a plain, tending to form meanders and to divide into several stretches with rather unstable characteristics. In this zone, the competence of the river is small and decreases toward the mouth, so that the river bed is raised by deposits of material carried from upstream. The river channel appears to obey Meyer-Petter and Muller's Law but the change of the river bed roughness in function of the mean velocity is different from the change usually observed. When the friction factor corresponding to the bed features was plotted as a function of a flow parameter, the experimental points obey a law different from the one currently used for predicting discharge curves. (Knapp-USGS)
W70-05201

THE ANALYSIS AND ESTIMATES OF ENERGY LOSSES BY INSTANTANEOUS VELOCITY DISTRIBUTION OF STREAMS WITH MOVABLE BED,
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02E.
W70-05204

INDUCTIVE APPROACH TO PHASES OF MOBILE-BED ROUGHNESS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05205

HYDRAULIC RESISTANCE OF A MOVABLE CHANNEL BED AND SEDIMENT GRADING INFLUENCE,
Akademiya Nauk Armyanskoi SSR, Erevan.
I. V. Egiazaroff.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A 9, p 68-75, 1967. 8 p, 5 fig, 16 ref.

Descriptors: *Roughness (Hydraulic), *Particle size, *Sediment transport, *Bed load, Alluvial channels, Roughness coefficient, Equations, Turbulent flow, Transition flow, Regime, Open channel flow.
Identifiers: Sediment size analysis.

A theoretical approach to bed load transport and channel resistance is presented, covering both uniformly graded and poorly sorted sediments. An empirical discharge-sediment size analysis is discussed and a grading curve is proposed to aid in granulometric studies. (Knapp-USGS)
W70-05206

LOCAL SCOUR IN BEDS OF SAND AND GRAVEL DOWNSTREAM FROM A SOLID APRON,
Sydney Univ. (Australia).
R. D. Watkins.
Inst Eng, Aust. Civ Eng Trans, Vol CEII, No 1, p 97-106, Apr 1969.

Descriptors: *Scour, Erosion, *Stream erosion, *Streambeds, Hydraulic models, Sands, Gravels, *Aprons, Potholes, Degradation, Depth, *River beds, Model tests, Prototypes, Hydraulics, Experimental data.
Identifiers: *Erodible-bed channels, *Bed profiles, Similitude, Scale effect, Rectangular channels, Bed movements.

A basic requirement for model data to be scaled into corresponding values in its prototype is knowledge of the similarity of the processes in both systems. An investigation was aimed at gaining knowledge of the performance of systems where scouring occurred in an erodible bed of noncohesive solid particles downstream from a hydraulic structure; the particular case studied was an erodible bed downstream from a solid horizontal apron in a rectangular channel. Observations were made of scour profile development in sand and in several gravels having particle sizes ranging between 1/50 in. and 3/4 in.; tests were made of each material being subjected to various waterflows having stream velocities up to 7 ft/sec. The main findings were: (1) scour development progressed from sheet scouring to pothole scouring; (2) a general similarity of pothole scour profiles occurred in all materials, although there were slight but noticeable differences; and (3) a new value for change of the maximum scour depth as a function of time is given. (USBR)
W70-05237

EROSION AT THE BASE OF FLIP BUCKETS,
Winsor Univ. (Ontario).
S. P. Chee, and P. V. Padiyar.
Eng J, Can, Vol 52, No 11, p 22-24, Nov 1969. 3 p, 3 fig, 1 tab, 14 ref.

Descriptors: Erosion, *Flip buckets, Energy dissipation, Scour, Depth, Hydraulic models, *Stream erosion, Geometric shapes, Model tests, Time, Hydraulics, Prototypes, *Spillways, *Stilling basins.
Identifiers: *Plunge basins, Bed profiles, Holes, Energy dissipators.

As a result of the performance of several recently constructed flip bucket spillways in which severe scour occurred at the bases threatening the structures, a new design philosophy is being studied. Causes of the unforeseen scour are: (1) irregularly shaped scour holes that form because of the heterogeneous composition of riverbeds, and (2) the erosive action of secondary currents generated in the irregularly shaped holes. The destructive secondary currents can be eliminated by excavating in advance a plunge pool corresponding to the configuration and dimensions of the scour hole obtained in model tests using a granular bed. The shapes of scour holes formed in a bed of homogeneous granular material using flip bucket models having 30 deg exit angles are reviewed. Plunge basin dimensions can be derived from the equations resulting from the study. (USBR)
W70-05245

FACTORS AFFECTING GROWTH OF ROOTED AQUATIC PLANTS IN A RESERVOIR,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
W. H. Peltier, and E. B. Welch.
Weed Science, Vol 18, No 1, p 7-9, 1970. 3 fig, 7 ref.

Descriptors: *Reservoirs, *Aquatic plants, Light, Water level fluctuations, Suspension, Turbidity, Rainfall, Sedimentary productivity, Sedimentation, Mosquitoes, Reservoir silting.
Identifiers: Pickwick Reservoir (Ala), Najas, Napas minor, Potamogeton pectinatus, Elodea canadensis, Light intensity, Langley/day units.

Nitrogen and phosphorus contents of Pickwick Reservoir, Alabama, were determined during the period 1965-1969. The results showed no correlation with year-to-year growth of rooted aquatics, Najas guadalupensis and Najas minor. Rank growth of the plants during 1962 and 1965 is attributed to limited rainfall and greater availability of light during these years. Extreme fluctuation of the reservoir level and reduced light penetration of turbid water are contributing factors. (Wilde-Wisconsin)
W70-05260

GRANULOMETER--A SEDIMENT ANALYZER DIRECTLY WRITING GRAIN SIZE DISTRIBUTION CURVES,
Central Geological Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 07B.
W70-05268

A HYDRAULIC CORER FOR USE IN WATER SATURATED SEDIMENT,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 07B.
W70-05398

PRELIMINARY EVALUATION OF A CORE SCINTILLATION COUNTER FOR BULK DENSITY MEASUREMENT IN MARINE SEDIMENT CORES,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
For primary bibliographic entry see Field 07B.
W70-05401

PIGMENTS FROM THE BOTTOM DEPOSITS OF AN ENGLISH LAKE,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05402

THE DEVELOPMENT OF DISCONTINUOUS GULLIES IN A PUMICE CATCHMENT,
Sydney Univ. (Australia). Dept. of Geography.
For primary bibliographic entry see Field 04D.
W70-05471

SUBSTITUTION OF SPACE FOR TIME IN A STUDY OF SLOPE DEVELOPMENT,
University of Western Ontario, London. Dept. of Geography.
D. M. Welch.
Journal of Geology, Vol 78, No 2, p 234-239, March 1970. 6 p, 7 fig, 15 ref.

Descriptors: *Geomorphology, *Erosion, *Slopes, Weathering, Topography, Terrain analysis, Geologic control, Land forming, Mountains.
Identifiers: *Slope development, Moraines.

Existing theories of slope development are questioned in that changes over time are not supported by direct evidence. Field data are presented which relate changes in the slope characteristics of recessional moraines to a time scale controlled by actual dates. Recently exposed moraines have irregular surfaces and show a wide range of slope angles. Frost-heaving and surface runoff create smooth slopes of 25-30 deg inclination. These changes take place uniformly with respect to time. No significant changes take place after 35 years. (Knapp-USGS)
W70-05473

TIDAL INLETS AND WASHOVER FANS,
Smithsonian Institution, Washington, D.C. Div. of Sedimentology.
For primary bibliographic entry see Field 02L.
W70-05474

CLAY MINERAL COMPOSITION OF LATE PLEISTOCENE AND HOLOCENE SEDIMENTS OF CASCADIA BASIN, NORTHEASTERN PACIFIC OCEAN,
Oregon State Univ., Corvallis. Dept. of Oceanography.
John R. Duncan, L. D. Kulm, and G. B. Griggs.
Financial support provided by grants from Nat Sci Found, and contract with Office of Naval Research. Journal of Geology, Vol 78, No 2, p 213-221, March 1970. 9 p, 6 fig, 20 ref. NSF Grants GP-5076 and GA-1246 and ONR Contract Nonr-1286 (10).

Descriptors: *Clay minerals, *Bottom sediments, *Pacific Ocean, Clays, Geology, Provenance, Columbia River, Mineralogy, Diagenesis, Glaciation, Weathering, Columbia River Basin.
Identifiers: Cascadia Basin.

Systematic lateral and vertical trends are detectable in proportions of montmorillonite, illite, and chlorite occurring in the lutites of late Pleistocene and Holocene sediments from southern Cascadia Basin and Blanco Fracture Zone. In the Holocene sediments, a lateral pattern radiates outward from the mouth of the Columbia River into the marine environment; the percentage of chlorite and, to a lesser extent, illite, increases with distance from the source. The percentage of montmorillonite presently introduced by the Columbia River to the Pacific Ocean is apparently higher than that of adjacent continental sources. In the late Pleistocene marine sediments, proportionally more illite is present than in the overlying Holocene sediments. Because the change in clay mineral composition is abrupt, and associated with the Pleistocene-Holocene faunal boundary, it is not believed to be the result of gradual marine diagenetic processes. Instead, it probably results from a glacially controlled change in the rate at which clays of varying composition are contributed by the different subbasins of the Columbia River to southern Cascadia Basin. (Knapp-USGS)
W70-05475

SUBMARINE CANYON ORIGIN ON UPPER CONTINENTAL SLOPE OFF CAPE HATTERAS,
Atlantic Oceanographic and Meteorological Labs., Miami, Fla.
For primary bibliographic entry see Field 02L.
W70-05476

QUANTITATIVE ANALYSIS OF BEACH SAND MOVEMENT, VIRGINIA BEACH, VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
John D. Boon, III.
Sedimentology, Vol 13, No 1-2, pp 85-103, October 1969. 19 p, 10 fig, 2 tab, 20 ref.

Descriptors: *Sediment transport, *Beaches, *Tracers, *Tracking techniques, Sands, Surf, Waves (Water), Currents (Water), Beach erosion, Sampling, Dunes, Dye releases, Statistics, Stochastic processes, Statistical models, Ocean waves, Littoral drift.
Identifiers: Virginia Beach (Va).

A simplified stochastic-process model involving statistical procedures is used to analyze sand tracer displacement data on an ocean beach. The procedures provide meaningful estimates of the direction and magnitude of the movement of beach sand through set intervals of time. Results of a single tracer experiment are reported for a beach located near Virginia Beach, Va. Using a rectangular sampling grid, tracers were recovered at fixed times, then considered as items in a sample of X and Y displacements from the point of release. Comparison of the adjusted means of these samples on a time-stratified basis gave estimates of average particle velocity in two dynamic zones: (1) swash zone: v (X) = 0.44 ft/min longshore; (2) surf zone: v (Y) = 0.37 ft/min offshore. Using an estimate of the thickness of the mobile layer (the depth interval in which semi-continuous motion of beach sand occurs), a further estimate of the rate of longshore sand transport was computed at 440 cu yards/day. (Knapp-USGS)
W70-05520

THE BED FORM ON RECTILINEAR AND CURVILINEAR RIVER AND BIG CHANNEL SECTIONS,
For primary bibliographic entry see Field 02E.
W70-05525

HYDRAULIC SOLUTION AND DEFINITION OF THE UNSTABILITY CRITERION OF STREAM WANDERING WITHIN BED, AND VORTEX ZONES,
Kharkov Vodokanalniiproekt Inst. (USSR). Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02E.
W70-05533

EFFECTS OF STAGES ON SCOUR ALONG RIVERBANKS,
US Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, Hydraulics Div.
For primary bibliographic entry see Field 02E.
W70-05534

COMPACTNESS VARIABILITY OF ESTUARINE SEDIMENTS: AN IN SITU STUDY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
For primary bibliographic entry see Field 02L.
W70-05541

2K. Chemical Processes

GEOCHEMICAL ENVIRONMENTS AND CARDIOVASCULAR MORTALITY RATES IN GEORGIA,
Geological Survey, Washington, D.C.
Hansford T. Shacklette, Herbert I. Sauer, and A. T. Miesch.
Available from Superintendent of Documents, U.S. Government Printing Office, Wash, DC 20402 - Price 50 cents. Geological Survey Professional Paper 574-C, pp C1-C39, 1970. 39 p, 7 fig, 13 tab, 25 ref.

Descriptors: *Water chemistry, *Water quality, *Public health, *Georgia, Trace elements, Weathering, Leaching, Diseases, Human pathology, Hardness (Water).
Identifiers: *Cardiovascular disease rates.

Nine contiguous counties of northern Georgia that have a low cardiovascular mortality rate lie in an area where the rocks, by weathering, continuously contribute a supply of minor elements to the soil. Nine counties of central and southcentral Georgia, in contrast, have a high cardiovascular mortality rate, and the soil is largely composed of materials that generally are deficient in weatherable minerals. The concentrations of the elements that were studied in soils from the two areas tend to be significantly different and are generally higher in the low-death-rate area. The difference in element composition of soils from the two areas is not apparent in analyses of most vegetables. The concentrations of most elements in tree samples tend to be higher in the low-rate area; therefore, trees appear to be more sensitive than vegetables to the variation in element content of soils. If geochemical differences between the two areas do, in fact, have a causal relationship to death from cardiovascular diseases, the cause would appear to be a dietary deficiency, rather than an excess, of the elements that were studied. (Knapp-USGS)
W70-05067

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
For primary bibliographic entry see Field 03A.
W70-05077

SOLUBILITIES OF SOME SILICATE MINERALS IN SALINE WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
A. Gene Collins.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price 45 cents. Office Saline Water Research and Development Progress Report No 472, August 1969. 27 p, 18 fig, 10 tab, 4 ref. OSW Contract No 14-01-0001-1146.

Descriptors: *Water chemistry, *Silicates, *Clay minerals, *Solubility, Calcium chloride, Sodium chloride, Saline water, Temperature, Pressure, Illite, Kaolinite, Montmorillonite, Saline water systems.
Identifiers: *Serpentine, *Nontronite, Sodium bicarbonate, Magnesium chloride, Silicon.

In the systems water, water-calcium chloride, water-magnesium chloride, water-sodium chloride, and water-sodium bicarbonate, the solubilities of illite, kaolinite, montmorillonite, nontronite, and a serpentine were determined as a function of time at ambient temperatures and pressures. Water-calcium chloride and water-sodium chloride systems from 30 deg to 200 deg C and from 2,500 to 15,000 psi were also investigated. In general, the solubilities of silicon from clay minerals decreased with increasing concentrations of dissolved salts at ambient temperatures and pressures. Empirical equations were derived from the smoothed curves plotted from silicon molality versus time. (Carstea-USGS)
W70-05078

INTEGRATION OF ENERGY CONVERSION AND BIOSYNTHESIS IN THE PHOTOSYNTHETIC BACTERIUM RHODOPSEUDOMONAS CAPSULATA,
Indiana Univ., Indianapolis. Dept. of Microbiology.
Gary A. Sojka, and Howard Gest.
Proceedings of the National Academy of Sciences, Vol 61, No 4, p 1486-1493, 1968. 2 fig, 3 tab, 22 ref.

Descriptors: *Light, *Light intensity, *Bacteria, *Energy conversion, Synthesis, Growth rates, Proteins.
Identifiers: *Intermittent illumination, Light cycles, Rhodopseudomonas capsulata, Protein:RNA ratio, ADP, AMP, Bacteriochlorophyll, Adenoisine triphosphate, Adenylate nucleotides.

The growth rate of bacterium Rhodopseudomonas capsulata was inhibited in intermittent light, even with cycles as short as 10 seconds. With a 60-minute cycle, the growth rate attained its maxiumum and was virtually zero in dark intervals. Cells grown in continuous saturating light showed the lowest protein: ribonucleic acid (RNA) ratio. Intermittency in 1-minute cycle lead to a protein decrease and a greater decrease in the RNA level. The values obtained with 1- and 2.4-minute cycles suggested that growth is a function of both ribosome content and the 'average' chemical energy flux. The 1-minute cycle has greatly increased bacteriochlorophyll (BChl) content of cells, indicating a correlation between the growth rate and BChl synthesis. The study suggested that intermittent illumination is pulsing of adenosine triphosphate (ATP) formation. Its congeners, adenosine di- and monophosphates (ADP and AMP) may regulate the biosynthesis of key macromolecular cell constitutents. In turn, the ATP generation rate and stable microconcentrations of adenylate nucleotides may control synthesis of macromolecular cell components. (Wilde-Wisconsin)
W70-05086

NITRATES IN THE ENVIRONMENT,
Wisconsin Univ., Madison. Dept. of Civil Engineering.

M. Starr Nichols.
Journal American Water Works Association, Vol 57, No 10, p 1319-1327, 1965. 25 ref.

Descriptors: *Nitrogen, *Atmosphere, *Biosphere, Fertilization, Nitrogen fixation, Denitrification, Wastes, Nitrogen fixing bacteria, Ammonia, Odor, Aquatic plants, Groundwater, Toxicity, Waste treatment.
Identifiers: Nitrogen deposits, Mineralization, Methemoglobinemia, Livestock poisoning, Silage gas, Odor prevention.

Atmospheric nitrogen, supplying 1600 pounds of elemental nitrogen per square foot of the world, is the most important source of nitrogen fertilizer. Nonsymbiotic and symbiotic nitrogen-fixing organisms fix nitrogen in the biosphere from atmospheric supplies. These organisms include 10 species of bacteria and 6 strains of blue-green algae. Denitrifying organisms cycle nitrogen back to the atmosphere. Nitrifying organisms, such as Nitrobacter, oxidize organic nitrogenous compounds in waste matter to nitrate after ammonification occurs. Mineralization of nitrogen in waste matter is responsible for most nitrogen mineral deposits found in the world. Slightly alkaline buffered environment and aerobic conditions will produce nitrates at enormous rates to supply nutrient needs. Aquatic growths in lakes from overfertilization may be nature's method of conserving nitrogen fertilizer. Presence of nitrogen compounds can indicate pollution. Nitrate concentration above 45 ppm might cause methemoglobinemia. Livestock is susceptible to nitrate poisoning. Sodium nitrate added to waste treatment lagoons limits odors and enhances biochemical oxygen demand reduction. Nitrates are added to natural water by leaching and runoff from wastes and poorly managed fertilizing practices. (Bannerman-Wisconsin)
W70-05099

EFFECT OF TOTAL ILLUMINATION UPON CONTINUOUS CHLORELLA PRODUCTION IN A HIGH INTENSITY LIGHT SYSTEM,
Army Natick Labs., Mass. Food Lab.
Robert O. Matthern, John A. Kostick, and Isao Okada.
Biotechnology and Bioengineering, Vol 11, No 5, p 863-874, 1969. 3 fig, 4 tab, 6 ref.

Descriptors: *Algae, *Light intensity, *Chlorella, *Productivity, Aerobic conditions, Fermentation, Photosynthesis, Temperature, Foods, Energy conversion, Light quality, Gases, Heat transfer, Nutrients, Hydrogen ion concentration, Infrared radiation, Chlorophyll, Time, Oxygen, Depth.
Identifiers: *Total illumination, *Continuous illumination, *Systems, Packed cell volume, Dry weight concentration, Light-dark phasing, Exchange, Concentrations, Cell count, HILIS.

Mass photosynthetic algal culture has been beset with two major problems preventing the ultimately economical and practical production of algae as food: large culture volume requirements and poor energy conversion efficiencies. A high intensity light system (HILIS) was designed and constructed to define the environmental parameters affecting algae production. HILIS incorporates the basic concepts of an aerobic fermenter for heterotrophic cells with high intensity illumination for photosynthetic studies. Of nine parameters considered, temperature and light intensity studies, using Chlorella 71105, have been completed. Total illumination was varied from 25,000 to 300,000 lumens (30 times intensity of sunlight as measured at earth's surface) in 7.7 liter culture. Effect of illumination upon growth was measured as cell concentration and total daily algal production when operating the HILIS as a continuous system at a dilution rate of 0.91/day. Growth may be expressed as a log function of illumination. A maximum algal concentration of 25.5 grams/liter, dry weight basis, was attained at 300,000 lumens. Algal production is a function of many environmental growth conditions, not merely illuminated surface area and depth of culture relative to light source. (Jones-Wisconsin)
W70-05106

THE EFFECTS OF IRON AND THORIUM IONS ON THE KINETICS OF PRECIPITATION OF BARIUM SULFATE,
Kansas Water Resources Research Inst., Manhattan.
Clark E. Bricker, and David J. Myers.
Available from the Clearinghouse as PB-190 570, $3.00 in paper copy, $0.65 in microfiche. Kansas State University Water Resources Research Institute Project Completion Report, Contribution No 34, 1969. 27 p, 11 fig, 3 tab, 18 ref, append. OWRR Proj No A-020-KAN.

Descriptors: *Water chemistry, *Chemical precipitation, *Catalysts, *Sulfates, Iron compounds, Magnesium compounds, Ions, Kinetics.
Identifiers: Barium sulfates, Thorium, Hydroxides, Chemical reaction kinetics.

The Coulter Counter has been used to record in situ growth and aging curves for the precipitation of barium sulfate. Teflon was found to catalyze the nucleation of barium sulfate, and iron and thorium were found to alter the mechanism of precipitation by changing the rates of nucleation and growth. A simple equation is derived from the Volmer-Becker-Doring theory, which relates the number of ions in the critical nucleus to the critical supersaturation ratio. This is used to examine the effect of thorium on homogeneous nucleation. Small concentrations of thorium were found to raise the critical supersaturation ratio and affect the growth rate. Similar effects were found when ferric ions were added, but magnesium ions were found to affect neither the nucleation nor the growth rates. It is postulated that the effects which were observed are due to hydroxy complexes which are formed by hydrolysis of the polyvalent cations. (Knapp-USGS)
W70-05122

ON THE RELATION BETWEEN DROP SIZE AND CONCENTRATION OF TRACE ELEMENTS IN RAINWATER,
Frankfurt Univ. (West Germany). Institut fuer Meteorologie und Geophysik.
Hans-Walter Georgii, and Dieter Wotzel.
Journal of Geophysical Research, Vol 75, No 9, p 1727-1731, March 20, 1970. 5 p, 4 fig, 7 ref.

Descriptors: *Water chemistry, *Trace elements, *Raindrops, Rainfall, Rain water, Water analysis, Solutes, Particle size, Evaporation.
Identifiers: Rain water chemistry.

Rainfall was separated according to drop-size spectrum with a drop-size discriminator. Chemical analysis of the different size fractions shows that small drops contain a higher concentration of impurities than large drops from the same rainfall. This result is valid for all components analyzed. The results can be explained on the basis of washout of trace substances and partial drop evaporation below the cloud base. (Knapp-USGS)
W70-05132

COMPOSITION OF DISSOLVED GASES IN THE GROUND WATERS OF CENTRAL KUZBASS,
P. I. Zelenovskiy.
Transl from Geokhimiya, No 4, p 501-505, 1969. Geochemistry International, Vol 6, No 2, p 384-387, January 1970. 4 p, 2 fig, 3 ref.

Descriptors: *Geochemistry, *Groundwater, *Coals, Gases, Methane, Carbon dioxide, Mineral water, Groundwater movement.
Identifiers: USSR, Kuzbass, Metamorphism.

The variation of nitrogen, methane, and carbon dioxide with depth in drill cores from anticlines and synclines in Central Kuzbass is presented graphically. A carbon dioxide, or carbon dioxide-nitrogen zone underlies a methane zone and is underlain by a second methane zone. This effect is discussed in relation to metamorphism of coal beds. (Knapp-USGS)
W70-05135

BORON IN GROUNDWATERS OF THE CRETACEOUS OF THE WEST CAUCASUS FORELAND,
Voronezh State Univ. (USSR).
A. Ya. Smirnova.
Transl from Geokhimiya, No 3, p 349-356, 1969. Geochemistry International, Vol 6, No 2, p 301-307, January 1970, 7 p, 1 fig, 2 tab, 12 ref.

Descriptors: *Geochemistry, *Water chemistry, *Brackish water, *Trace elements, Groundwater movement, Solubility, Aqueous solutions, Geologic control, Faults (Geology), Geology, Hydrogeology, Leaching.
Identifiers: USSR, West Caucasus Foreland, Boron.

The distribution of B in waters of Cretaceous deposits of the Western Caucasus is closely related to the degree of mineralization and the chemical composition of the waters. The B content increases for increasing salt content in the range 0.5 - 25 g/liter, but decreases in brines and highly saline waters. The most favorable waters for the accumulation of B are brackish and weakly saline waters of the sodium bicarbonate type. The amount of B is also related to the tectonic structure of the area: B waters are usually associated with deep faults and mud volcanoes. (Knapp-USGS)
W70-05137

HYDROGEOCHEMISTRY OF GOLD,
A. M. Chernyayev, L. E. Chernyayeva, M. N. Yeremeyeva, and M. I. Andreyev.
Transl from Geokhimiya, No 4, p 449-459, 1969. Geochemistry International, Vol 6, No 2, p 348-358, January 1970. 11 p, 4 fig, 5 tab, 36 ref.

Descriptors: *Geochemistry, *Groundwater, *Surface waters, *Gold, Trace elements, Leaching, Hydrogeology, Water chemistry, Igneous rocks, Clays, Sandstones, Carbonate rocks, Ions, Colloids, Suspension.
Identifiers: USSR, Gold hydrogeochemistry.

A literature review and original analyses of natural waters of North Kazakhstan were used in a study of the Au content of natural waters and the chemical form of Au during migration. Analyses range from less than 0.1 to 4 ppb Au and show that the Au content does not depend on the chemical composition of the waters. Groundwaters circulating above Au-bearing ore bodies have high concentrations of Au, As, Ag, and Bi. Au can migrate in the form of ions, colloids, mechanical suspensions, and other forms depending on the particular physiochemical conditions. (Knapp-USGS)
W70-05138

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07A.
W70-05170

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-05176

COMPARISON OF METHODS OF CALCULATING PARTICLE SIZE FROM HINDERED SETTLING RESULTS AND ITS APPLICATION TO INORGANIC OXYSALT PRECIPITATES,
Salford Univ. (England). Dept. of Chemistry; and Stand Grammar School, Whitefield (England).
For primary bibliographic entry see Field 02J.
W70-05179

DATA FOR SPRINGS IN THE NORTHERN COAST RANGES AND KLAMATH MOUNTAINS OF CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02F.
W70-05182

A CHEMICAL ENGINEER'S GUIDE TO SEA-WATER,
Dow Chemical Co., Freeport, Tex.
W. F. McIlhenny, and M. A. Zeitoun.
Chem Eng, Vol 76, No 24, 25, p 81-86, 251-256, Nov 3, 17, 1969. 12 p, 6 fig, 8 tab, 13 ref.

Descriptors: *Sea water, Chemical engineering, Oceans, *Saline water, Saline water systems, Salinity, Physical properties, *Water chemistry, Chemical properties, Marine animals, Marine borers, Marine engineering, Fouling, Corrosion, Waste disposal, Chlorination, Chemical analysis, Chemical precipitation, Foaming, Demineralization, Water utilization.
Identifiers: Salt recovery, Salt solutions.

In exploiting the ocean's resources, from mineral recovery to eventual construction of plants on the sea floor, chemical engineers must become familiar with the properties and behavior of sea water. Sea water is more than a solution of mineral ions; it also contains dissolved gases, complex molecular aggregations, a wide variety of organic compounds, colloidal and larger suspended matter, insoluble organic compounds, and living creatures. Getting to know sea water is a difficult task. Most oceanographic data pertain to areas some distance from the shore, but engineers are concerned with coastal and estuarine sea waters that vary in concentration composition because of dilution, biological processes, and wastes. The concentration of dissolved minerals is described in terms of abundance, salinity, chlorinity, and chlorosity. The physical properties of sea water and the general chemistry of the ocean are presented; corrosion, foaming, supersaturation, deposition of solids, fouling, and biological pests are discussed. (USBR)
W70-05224

THE EFFECT OF LIGHT ON NITRATE AND NITRITE ASSIMILATION BY CHLORELLA AND ANKISTRODESMUS,
University Coll., London (England). Dept. of Botany.
I. Morris, and J. Ahmed.
Physiologia Plantarum, Vol 22, No 6, p 1166-1174, 1969. 5 tab, 20 ref.

Descriptors: *Algae, *Light, *Nitrates, *Nitrites, Aerobic conditions, Anaerobic conditions, Chlorella.
Identifiers: Carbon dioxide, Chlorella pyrenoidosa, Ankistrodesmus braunii, Dunaliella tertiolecta, DCMU inhibitor.

Assimilation of nitrate and nitrite nitrogen by Chlorella pyrenoidosa and Ankistrodesmus braunii was observed under illumination in aerobic and anaerobic media in the absence of carbon dioxide. The presence of carbon dioxide failed to influence the assimilation of Chlorella, but stimulated that of Ankistrodesmus. The ratios of oxygen:nitrate and oxygen:nitrite varied in different trials and were higher than calculated values for oxygen of 2.0 and 1.5 expected in reduction of nitrate and nitrite, respectively. Oxygen evolution was completely arrested by 3- (3'-4'-dichlorophenyl)-1-1 dimethyl urea (DCMU) at a concentration of 0.000004M. However, nitrite assimilation by both algae and nitrate assimilation by Ankistrodesmus were less depressed by the inhibitor. (Wilde-Wisconsin)
W70-05261

THE EFFECT OF DELETERIOUS CONCENTRATIONS OF COPPER ON THE PHOTOSYNTHESIS OF CHLORELLA PYRENOIDOSA,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
E. Steemann Nielsen, L. Kamp-Nielsen, and S. Wium-Andersen.
Physiologia Plantarum, Vol 22, No 6, p 1121-1133, 1969. 7 fig, 4 tab, 13 ref.

Descriptors: *Copper sulfate, *Photosynthesis, *Chlorella, *Toxicity, Light, Hydrogen ion concentration, Potassium, Herbicides, Fungicides.
Identifiers: *Chlorella pyrenoidosa, Cytoplasmic membranes, Cell division, Skeletonema costatum.

This study, conducted under illuminated conditions, revealed that the maximum influence of copper sulfate on Chlorella pyrenoidosa is exerted during the first 24 hours of the plant's contact with the chemical. A significant depression of photosynthesis was observed at copper concentration as low as about 1 microgram/liter. A decrease of the medium reaction from pH 8 to pH 5 required a 10 times increase in copper concentration to obtain the same deleterious effect. Addition of potassium decreased the effectiveness of the herbicide and indicated that the eradicating effect of copper is not due to penetration of this ion into the plasma, but to a binding to the cytoplasmic membrane and arrested division of cells. Other cations tend also to displace copper from the active sites of the membranes. (Wilde-Wisconsin)
W70-05370

THE ADAPTATION OF PLANKTON ALGAE. IV. LIGHT ADAPTATION IN DIFFERENT ALGAL SPECIES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
Erik G. Jorgensen.
Physiologia Plantarum, Vol 22, No 6, p 1307-1315, 1969. 4 fig, 2 tab, 15 ref.

Descriptors: *Plankton, *Algae, *Light intensity, Chlorella, Chlorophyta, Diatoms, Pigments, Chlorophyll, Photosynthesis, Growth rate, Organic matter, Scenedesmus, Chlamydomonas, Freshwater, Marine algae, Enzymes.
Identifiers: *Adaptation, *Species, Cyclotella Meneghiniana, Light-saturated rate, Cell volume, Nitzschia closterium, Nitzschia palea, Chloroplasts, Scenedesmus obliquus, Scenedesmus quadricauda, Chlorella pyrenoidosa, Chlorella vulgaris, Monodus subterraneus, Ankistrodesmus falcatus, Chlamydomonas moewusii, Skeletonema costatum, Synechococcus elongatus.

Two types of plankton algae adapt to light intensities differently--Chlorella and Cyclotella. The Chlorella type is mostly found among green algae and adapts to a new light intensity chiefly by changing the pigment content. The cells adapted to a high light intensity have a lower chlorophyll a content per cell than cells adapted to low light intensity, the latter with rather low light saturation. The light-saturated rate of photosynthesis is usually lower for cells adapted to a high light intensity than for cells adapted to a low light intensity. Actual photosynthesis (photosynthesis at the light intensity where the cells are grown) is not much higher at high light intensity than at low. The Cyclotella, prevalent among diatoms, adapts only by changing the light-saturation rate. Chlorophyll content is the same in cells grown at low and high intensities. Light saturation for cells grown at a low light intensity is rather high. The light-saturated rate is much higher in the case examined at high intensity than at low. Actual photosynthesis is considerably higher for cells grown at high light intensities opposed to low. Transitional types occur. (Jones-Wisconsin)
W70-05381

SEA SURFACE CHEMISTRY: ORGANIC CARBON AND ORGANIC AND INORGANIC NITROGEN AND PHOSPHORUS IN SURFACE FILMS AND SUBSURFACE WATERS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
P. M. Williams.
Deep-Sea Research, Vol 14, p 791-800, 1967. 7 tab, 33 ref.

Descriptors: *Nitrogen, *Ocean water, *Air-water interfaces, *Nitrogen cycle, Nitrification, Phosphorus, Environmental effects, Microenvironment, Carbon, Nitrate, Subsurface waters, Organic matter, Chemical properties.
Identifiers: *Sea surface phenomena, Marine snow, Sea surface films, Euphotic zone, Peru, Southern California, Particulate matter.

The microenvironment of the sea surface is a few millimeters to Angstroms thick, but it is an important intermediary source, or sink, for airborne organisms and inorganic compounds. Formation and eventual fate of particles and dissolved organic matter in euphotic zones is relevant to sea surface phenomenon. From surface film, subsurface and 15-20 centimeter deep sampling off the coast of Peru and Southern California, curve concentration gradient for dissolved and particulate carbon, nitrogen, and phosphorus are reported. Nitrate was concentrated in all surface films. Bacterial nitrification is the most likely cause. Ratios between organic carbon, nitrogen and phosphorus were calculated to indicate origin of particulate organic detritus. Surface film gave no significant correspondence between nitrogen/phosphorus and carbon/nitrogen, while high nitrogen/phosphorus ratios indicated rapid phosphorus mineralization. Organic nitrogen is lost primarily by sedimentation. Because of high concentration of nitrogen as ammonium, nitrate and organic nitrogen acting as nitrogen reservoir in sea surface films, a closed system of nitrogen recycling might exist in the sea. (Bannerman-Wisconsin)
W70-05411

THE ROLE OF COAGULATION IN NATURAL WATERS,
Harvard University, Cambridge, Mass. Div. of Engineering and Applied Physics.
Hermann H. Hahn, and Werner Stumm.
American Journal of Science, Vol 268, No 4, p 354-368, April 1970. 15 p, 6 fig, 2 tab, 27 ref.

Descriptors: *Water chemistry, *Coagulation, *Flocculation, *Clays, *Clay minerals, Ions, Solutes, Deposition (Sediments), Sedimentation, Turbidity, Colloids, Chemical precipitation, Gels, Hydrosols (Dispersions), Mineralogy, Water properties, Silica, Montmorillonite, Kaolinite, Illite.
Identifiers: Colloid chemistry.

The rate of coagulation of various colloids (montmorillonite, kaolinite, illite, silica) was determined on the basis of theoretical calculations and experimental measurements in solutions of specified conditions of pH, ionic strength, or individual concentration of ions. The size of colloidal aggregates formed in a natural water within a certain time of reaction is calculated from these rates of coagulation. With this information the effects of aggregation, sedimentation, and horizontal transport of colloids in a natural body of water were discussed: the changes in the concentration and composition of the dispersed phase and the horizontal and vertical change in the pattern of sedimentation. The developed models represent first approximations and apply only within the limits of the necessary assumptions. However, they show that it is useful to apply principles of colloid chemistry in describing the composition of natural waters and underlying sediments. (Knapp-USGS)
W70-05472

MICROBIOLOGICAL ASSAYS OF SEA WATER USING RADIOISOTOPES-AN ASSAY FOR VITAMIN B-12 MEASURED BY C-14 ASSIMILATION,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
Kenneth Gold.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 341-345, 1967. 5 p, 5 fig, 14 ref. AEC Contract CU-3233-2.

Descriptors: *Bioassay, *Sea Water, *Carbon radioisotopes, *Vitamin B, Optical properties,

Analytical techniques, Microorganisms, Incubation, Radioisotopes.
Identifiers: *Microbiological assays, Cyclolella nana.

Microbiological assay methods can use radioisotopes, particularly C-14, to determine seawater constituents. In marine bioassay, great emphasis has been placed upon methods of detecting vitamin B-12. The usual method to measure the responses to varying concentrations of B-12 is to compare cell density or optical density after incubation. The diatom Cyclotella nana was used in experimental studies; preparation of external and internal standard solutions, assay and incubation methods are briefly discussed, and data are presented graphically. Sensitive responses have been obtained from 0.1 micro-microgram/liter of vitamin B-12 and it is believed that the lowest limits can be extended still further. (Carstea-USGS)
W70-05546

2L. Estuaries

ORGANIC CHELATORS: FACTORS AFFECTING PRIMARY PRODUCTION IN THE CROMWELL CURRENT UPWELLING,
Woods Hole Oceanographic Institution, Mass.
Richard T. Barber, and John H. Ryther.
Journal Experimental Marine Biology and Ecology, Vol 3, p 191-199, 1969. 2 fig, 3 tab, 15 ref.

Descriptors: *Organic matter, *Ocean circulation, *Currents (Water), Inorgnaic compounds, Nutrients, Aquatic life, Sea water, Fertility, Chelation, Primary productivity.
Identifiers: *Cromwell Current, *Pacific Ocean, Chlorophyll a, Upwelled water, Equator, Carbon-14 uptake, Ethylenediamine tetraacetic acid, Disodium-EDTA, Organic chelators.

Water from the subsurface of the Cromwell Current upwells at the equator in the eastern Pacific Ocean and spreads north and south. This water is rich in inorganic nutrients but lower in dissolved organic carbon than aged, productive water to the north and south. Enrichment experiments with the nutrient-rich, newly upwelled water did not improve photosynthesis; however, the addition of disodium-EDTA or the filtrate from an undefined zooplankton homogenate, did result in increased carbon-14-bicarbonate uptake. Non-enriched phytoplankton populations from 2 deg south, took up carbon-14-bicarbonate at a rate equal to the zooplankton extract enriched culture from 0 degree. The abundance of chlorophyll a at these stations was initially the same, emphasizing that the differences in carbon-14 uptake were due to changes in growth rate and not the initial standing crop. The data suggest that the upwelled water is limited by the absence of certain chelating substances. As the upwelled water ages, the organisms apparently gradually enrich the water with organic compounds, some of which may be effective chelators. The aged water at 2 deg S and 2 deg N contained a slightly higher dissolved organic carbon concentration and apparently a higher concentration of organic chelators. (Haskins-Wisconsin)
W70-05087

A STUDY OF POLLUTION IN THE THAMES ESTUARY,
Water Pollution Research Lab., Stevenage (England).
A. L. H. Gameson, and I. C. Hart.
Chemistry and Industry, p 2117-2123, December 17, 1966. 5 fig, 3 ref.

Descriptors: *Water pollution, *Estuaries, Dissolved oxygen, Treatment facilities, Water quality, Ammonia, Nitrogen, Temperature, Flow, Fresh water, Biochemical oxygen demand, Salinity, Sewage, Aeration, Dredging, Chlorides, Tides, Anaerobic, Detergents, Distance.
Identifiers: *Thames Estuary (England), England, Teddington (England), Greater London Council, Port of London Authority.

An investigation was begun in 1949 to provide information on which recommendations could be based for reducing the pollution of the Thames Estuary. The main objectives were to determine effects of various factors on distribution of dissolved oxygen, and to develop methods by which this distribution could be predicted for any combination of conditions that might arise. The condition of the middle (most polluted) reaches of the Thames Estuary, as judged by the dissolved oxygen content of the water, showed a marked improvement at the beginning of 1964, following the installation of the secondary treatment plant in Southern Outfall Sewage Works; this improvement was maintained throughout 1964-1965. The lower reaches have shown no improvement and satisfactory conclusions for this have not been reached as many factors are involved. Among them are deposition of organic solids, removal by dredging, changes in dredging, possible return of oxidizable matter to the estuary, variations of sampling methods, and longitudinal mixing. The marked deterioration in 1949-1950 is attributable to the widespread introduction of synthetic anionic detergents. In 1964-1965 there was no anaerobic reach established at any time, a situation that had not existed for several decades. (Jones-Wisconsin)
W70-05093

MEASUREMENT AND DETECTION OF EUTROPHICATION,
Central Coastal Regional Water Quality Control Board, San Luis Obispo, Calif.
Thomas E. Bailey.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 93, No SA6, p 121-132, 1967. 6 fig.

Descriptors: *Correlation analysis, *Fluorometry, *Fluorescence, *Chlorophyll, *Eutrophication, Primary productivity, Phytoplankton, Photosynthesis, Biomass, Cultures, Plant physiology, Algae, Diurnal distribution, Oxygen, Dissolved oxygen, Measurement, Estuaries, Sanitary engineering, Water treatment, Waste treatment.
Identifiers: Sacramento-San Joaquin Delta, California Water Plan, Delta Water Facilities (Calif), Oxygen dynamics, Sacramento-San Joaquin Estuary, Environmental relationships, Fluorometric chlorophyll technique.

Primary productivity, an important indicator of eutrophication, was measured indirectly as chlorophyll concentration of phytoplankton standing crop. Pigment concentrations were determined spectrophotometrically as absorbance with a 90% acetone solvent. Fluorescent dye tracer techniques were modified to measure chlorophyll fluorometrically. Light scattering, quenching, and variation in phytoplankton were considered to influence fluorescence measured by the Turner Model 111 Fluorometer, establishing chlorophyll as a good indicator of eutrophication based on relationship with phytoplankton standing crop and photosynthetic activity. An empirical equation was defined for estimating photosynthesis from chlorophyll data. Dependence of dissolved oxygen supersaturation on plant metabolism related diurnal oxygen concentration to chlorophyll. Fluorometric technique of measuring chlorophyll is a fast and flexible method for measuring primary environmental relationship and biological monitoring in such installations as sewage treatment plants. Once primary environmental chlorophyll relationships are defined, the fluorometric technique can be used almost without limitation. (Bannerman-Wisconsin)
W70-05094

NITROGEN TURNOVER IN MARINE AND BRACKISH HABITATS. IV. UPTAKE OF THE EXTRACELLULAR PRODUCTS OF THE NITROGEN-FIXING ALGA CALOTHERIX SCOPULORUM,
Westfield Coll., London (England). Dept. of Botany.
K. Jones, and W. D. P. Stewart.
Journal Marine Biological Association of the United Kingdom, Vol 49, No 3, p 701-716, 1969. 5 fig, 9 tab, 33 ref.

Descriptors: *Algae, *Brackish water, *Nitrogen, *Metabolism, Uptake, Adsorption, Tracers, Marine microorganisms, Fungi, Bacteria.
Identifiers: Calothrix scopulorum, Metabolic uptake, Heterotrophic bacteria, Proteolytic bacteria, Extracellular nitrogen, Nitrogen-15, Blue-green algae.

Calothrix scopulorum is a marine blue-green alga capable of fixing nitrogen and liberating large portions into the environment. Tests with laboratory cultures of algae, fungi, and bacteria, in a medium of nitrogen-15 labeled products of Calothrix scopulorum, indicated uptake of nitrogen-15 by these organisms. Uptake was also evident when alternate nitrogen sources were present. Natural C scopulorum and algae were collected and exposed to gaseous nitrogen-15 with algae again incorporating extracellular nitrogen-15 nitrogen. Uptake of extracellular nitrogen has both an active and passive mechanism. Active metabolic uptake was sometimes more significant than adsorption in passive uptake. Living cells had a higher nitrogen-15 concentration than dead cells. Organisms grew in a strict extracellular environment, but not as fast as when nitrate nitrogen was available. When labeled extracellular nitrogen was sorbed on inorganic nuclei a precipitate formed. Organisms in brackish or littoral water might use extracellular nitrogen as a sole nitrogen source. Measurements of free nitrogen species in the sea is not a true indicator of biologically important nitrogen concentration. (Bannerman-Wisconsin)
W70-05101

EUTROPHICATION OF A TIDAL ESTUARY,
Cornell Univ., Ithaca, N.Y. Dept. of Conservation.
John P. Barlow, Carl J. Lorenzen, and Richard T. Myren.
Limnology and Oceanography, Vol 8, No 2, p 251-262, 1963. 2 fig, 5 tab, 29 ref.

Descriptors: *Estuaries, *Eutrophication, *Fertilizers, Nutrients, Tidal waters, Saline water, Phosphorus, Nitrogen, Organic matter, Decomposing organic matter, Biochemical oxygen demand, Chemical oxygen demand, Photosynthesis, Oxygen, Respiration, Circulation, Fresh water.
Identifiers: Bathymetric charts, Oxygen:chlorophyll a ratio, Moriches Bay (L I - N Y), Forge River (N Y), Ultimate oxygen demand, Organic matter production, Allocthonous materials, Chlorophyll a.

Moriches Bay on Long Island, New York, has provided a dramatic illustration of eutrophication of tidal waters under the influence of heavy fertilization. Despite pronounced stratification of salinity, the nutrients carried seaward from the estuary of the Forge River do not accumulate in the deeper layer. Nearly all organic matter of the estuary was produced locally by the dense algal population, a conclusion substantiated by values for chlorophyll a, photosynthesis: respiration ratios, and the rate of oxidation of allochthonous organic matter. (Wilde-Wisconsin)
W70-05102

PHOSPHORUS CONCENTRATIONS IN THE PAMLICO RIVER ESTUARY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 05C.
W70-05115

A HEAT BUDGET OF THE WATER IN BARROW STRAIT FOR 1962,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
For primary bibliographic entry see Field 02C.
W70-05136

MATHEMATICAL TIDAL STUDY OF ST. LAWRENCE RIVER,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering; and National Research Council of Canada, Ottawa (Ontario).
J. William Kamphuis.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7141, pp 643-664, March 1970. 22 p, 17 fig, 8 ref, append.

Descriptors: *Estuaries, *Tidal effects, *Mathematical models, *St. Lawrence River, Equations, Digital computers, Model studies, Water level fluctuations, Tidal waters, Tides.
Identifiers: Tidal models.

A mathematical study of the tidal motion in the St. Lawrence River and Estuary is presented. Differential equations, schematization and difference equations are analyzed and a detailed description is given of three separate difference schemes, an explicit model and two implicit ones. The solution of the large matrices resulting from the implicit schemes is detailed at length and the three schemes are compared as to their results and relative advantage. (Knapp-USGS)
W70-05157

THE CONTROL OF ESTUARINE POLLUTION,
Forth River Purification Board, Langgarth (Scotland).
W. F. Collett.
Chemistry and Industry, p 25-29, January 7, 1967.

Descriptors: *Estuaries, *Water pollution effects, *Water pollution control, Navigation, Standards, Recreation, Fisheries, Thermal water, Powerplants, Fish, Crustaceans, Self-purification.
Identifiers: Scotland, Britain, Comprehensive pollution control, River Forth (Scotland), River Clyde (Scotland).

Scotland's views on comprehensive control of effluent discharges into estuaries are outlined. Control methods to achieve water quality suitable for various purposes are described and the following conclusions are drawn: full committal to the self-purification capacity of an estuary is impractical; estuaries should be divided into zones where discharges are subject to similar limitations, or more practically, on equality of effort rather than results; with wide margin of safety attached to pollution limitation, a complete knowledge of the self-purification capacity of an estuary is unnecessary before controls are applied; discharge of effluents must be controlled for the benefit of the estuary; control should be primarily for the current use of an estuary; remedial work should be phased according to availability of funds and expertise; priority must be given to those discharges which by their size, strength, or situation are the dominating factors in estuarine pollution; and if estuarine usage is to be maximal, the consideration is not how little need be done to improve effluents but how much can be required without excessive hardship to any segment of industry or the community. (Haskins-Wisconsin)
W70-05262

AMINO ACID FLUX IN AN ESTUARY,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
John E. Hobbie, Claude C. Crawford, and Kenneth L. Webb.
Science, Vol 159, p 1463-1464, March 1968. 1 tab, 10 ref.

Descriptors: *Amino acids, *Estuaries, *Absorption, Organic matter, Virginia, Aquatic bacteria, Physiological ecology, Phytoplankton, Photosynthesis, Carbon radioisotopes, Regression analysis, Kinetics, Lakes, North Carolina.
Identifiers: Substrate concentration, Turnover time, Maximum uptake velocity, Transport affinity constant, Uptake velocity, Heterotrophy, Isoleucine, Virginia Institute of Marine Science, Ornithine, Histidine, Arginine, Organic solutes, York River (Va), Glycine, Serine, Microbial ecology, Methionine, Radiocarbon uptake techniques, Dissolved free amino acids, Technicon Auto Analyzer, Lineweaver-Burk equation, Aspartic acid, Threonine, Alanine, Pamlico River (NC), Transport systems, Glutamic acid, Valine, Cary electrometer, Leucine, Lysine, Tyrosine, Proline, Phenyl alanine.

Assessment of the role in heterotrophy of specific organic solutes in the hydrosphere requires knowledge not only of their instantaneous concentrations, but also of their flux through the ecosystem. Useful ecological parameters can be derived from kinetic analysis of uptake by aquatic microbiota (particularly bacteria) of radiocarbon-labeled organic substrates. Analysis for dissolved free amino acids (DFAA) in York River (Virginia) estuary revealed presence of 17, for total concentration of 38 micrograns/liter, data consistent with values reported for open ocean, other estuaries, and lakes. In highest concentrations (reported as micrograns/liter) were glycine (16.85), serine (4.91), ornithine (3.17). Kinetic analysis of uptake by planktonic bacteria of 14 amino acids showed highest flux rates (micrograms/liter per hour) for glycine (0.423), methionine (0.171), and serine (0.133). Because these data need correction for respired carbon, true flux values may be 2-fold greater. Based on these data, and others for photosynthesis, fluxes represent 1 to 10% of daily photosynthetic carbon fixation. Although methionine and threonine are present in similar concentrations, methionine moved through DFAA pool 8-fold faster than threonine, illustrating ecological importance of information of dynamic properties of the system. (Eichhorn-Wisconsin)
W70-05271

FACTORIAL PRODUCTIVITY EXPERIMENTS IN A SHALLOW ESTUARY: ENERGETICS OF INDIVIDUAL PLANKTON SPECIES IN MIXED POPULATIONS,
Oak Ridge National Lab., Tenn.
Bernard C. Patten, and George M. Van Dyne.
Limnology and Oceanography, Vol 13, No 2, p 309-314, 1968. 1 fig, 1 tab, 8 ref.

Descriptors: *Plankton, *Estuaries, *Productivity, Energy, Population, Photosynthesis, Respiration, Oxygen requirements.
Identifiers: Skeletonema costatum, York River (Va), Nonlinear programming, Least squares analysis, Light-dark bottle technique.

Estimates of specific plankton population productivity parameters from water samples containing mixed species were made by means of nonlinear programming. An illustration of the method is provided by specimen data relevant to in situ populations of Skeletonema costatum, inhabiting York River, Virginia. Observation of changes in the estimated energy-processing characteristics of this diatom suggested that the organism possesses a wide physiological adaptation. Computed gross production and respiration were correlated positively; estimates of individual's productive output were inversely related to corresponding values for other species, suggesting interspecific competition. An appraisal of the accuracy of obtained results will require direct determinations. (Wilde-Wisconsin)
W70-05273

UNDERWATER LASER SURVEYING SYSTEM,
TRW Systems Group, Redondo Beach, Calif.
For primary bibliographic entry see Field 07B.
W70-05318

THE ACCURACY OF PRESENT WAVE FORECASTING METHODS WITH REFERENCE TO PROBLEMS IN BEACH EROSION ON THE NEW JERSEY AND LONG ISLAND COASTS,
Corps of Engineers, Washington, D.C. Beach Erosion Board.
Willard J. Pierson, Jr.
Available from the Clearinghouse as PB-106 577, $3.00 in paper copy, $0.65 in microfiche. Technical memo., Apr. 51, 83 p., Rept no. TM-24.

Descriptors: *Beaches, Erosion, *Ocean waves, Predictions, Altitude, Accuracy, Seacoast, New Jersey, New York.
Identifiers: Beach erosion, Long Island (New York), Long Branch (New Jersey).

Detailed weather data and wave data for every four hours were obtained from 22 April 1948 to 31 May 1948. An attempt was made to fit the observed significant height and significant period to the forecasted significant height and significant period within the range of accuracy of the weather data. It was, in general, possible to obtain good agreement between the observed and forecasted significant heights.
W70-05319

AN ANALYSIS OF MARINE CORER DYNAMICS,
Navy Underwater Sound Lab., New London, Conn.
For primary bibliographic entry see Field 07B.
W70-05378

OSMOTIC ACCOMMODATION IN CALLINECTES SAPIDUS RATHBUN,
Gulf Coast Research Lab., Ocean Springs, Miss.; and Mississippi State Univ., State College. Dept. of Zoology.
Buena S. Ballard, and Walter Abbott.
Comparative Biochemistry and Physiology, Vol 29, p 671-687, 1969. 5 fig, 3 tab, 43 ref.

Descriptors: *Crabs, *Physiological ecology, *Estuaries, Salt tolerance, Amino acids, Salinities, Mississippi, Migration patterns, Animal behavior, Environmental effects.
Identifiers: *Callinectes sapidus, *Osmoregulation, Blue crabs, Temperature effects, Salinity effects, Euryhalinity, Ninhydrin-reactive substances, Hyporegulation, Hyperregulation, Melting time techniques, Freezing point osmometry, Blood osmoconcentrations, Mississippi Sound, Pascagoula River (Miss), Homoiosmoticity, Iso-osmoticity, Osmotic work, Bluff Creek (Miss), Gulf Coast Research Laboratory, Ocean Springs (Miss).

Salinity-correlated, sexually differentiated migratory patterns, which may be physiologically or behaviorally caused, occur in blue crabs (Callinectes sapidus), a euryhaline species. In adult crabs, ambient salinity and temperature influence blood osmoconcentrations, as determined from melting times or freezing point osmometry. Crabs demonstrated good hyperregulation at low salinities; were approximately homoiosmotic at salinities in range 20-25 parts/thousand (ppt); and approached iso-osmoticity at higher salinities. Hyporegulation occurs only at high temperature (28-30C). Blood osmoconcentration varies inversely with temperature, seasonal effects (apparently due to environmental temperature at which animals are collected) persisting under thermally constant experimental conditions. In a range of salinities, approximately 1-20 ppt, blood osmoconcentrations are lower in males than in females, steeper osmotic gradient in latter apparently requiring greater energy expenditure for regulation. When animals of either sex are changed to a new ambient salinity, post-acclimation osmoconcentration of their blood is greater after change from high to low salinity than after converse change. Hemoconcentration of total organic substances, including those reacting as amino acids, vary independently of blood osmoconcentration, whereas inorganic substances vary similarly, suggesting that latter are responsible for osmoregulation. (Eichhorn-Wisconsin)
W70-05383

THE MOLECULAR NATURE OF ORGANIC MATTER IN LAKES AND OCEANS, WITH

LESSER REFERENCE TO SEWAGE AND TERRESTRIAL SOILS,
Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 02I.
W70-05395

STANDING CROP OF FORAMINIFERA IN SUBLITTORAL EPIPHYTIC COMMUNITIES OF A LONG ISLAND SALT MARSH,
City Coll., New York. Dept. of Biology; Queens Coll., Flushing, N.Y. Dept. of Science Education; and Pace Coll., New York. Dept. of Biology.
J.J. Lee, W. A. Muller, R. J. Stone, M. E. McEnery, and W. Zucker.
Marine Biology, Vol 4, No 1, p 44-61, 1969. 7 fig, 18 tab, 53 ref.

Descriptors: *Aquatic life, *Crustaceans, *Standing crop, Epiphytology, Distribution, Ecotypes, Marshes (Salt), Methodology, Ammonia.
Identifiers: *Foraminifera, Species diversity, Diversity indices, Zostera, Enteromorpha, Ulva, Polysiphonia, Protelphidium, Quinqueloculina, Elphidium.

Foraminifera showed a seasonal shift in abundance in epiphytic communities, being most abundant on Enteromorpha in early summer and later shifting to communities on Zostera, Ulva, and other aquatic plants. Foraminiferans were rarely found on Fucus or Codium. Some foraminiferan species showed substrate preferences. A general increase in numbers of foraminiferans occurred as summer progressed, with a trend toward greater species diversity in late July to early August. Decaying vegetation had greatest standing crop and lowest species diversity indices; diversity indices for foraminiferan communities on various aquatic plants varied from 0.196 to 0.990 (formula for computing diversity is not given). Probability and coincidence tables were constructed to test independence of distribution of foraminiferan species; results suggest several species have common microenvironmental dependence. Both positive and negative correlations of species distributions were noted. Tabular data include probability and coincidence tables and results of coincidence analysis; figures include photographs of 22 species of foraminifera. (Voigtlander-Wisconsin)
W70-05413

TIDAL INLETS AND WASHOVER FANS,
Smithsonian Institution, Washington, D.C. Div. of Sedimentology.
J. W. Pierce.
Journal of Geology, Vol 78, No 2, p 230-234, March 1970. 7 p, 1 fig, 1 plate, 10 ref. NSF Grant G-16362. SRF Grant RA-3307.

Descriptors: *Sedimentation, *Sediment transport, *Deposition (Sediments), *Inlets (Waterways), *Estuaries, Deltas, Regime, Channel morphology, Coasts, Geomorphology, Alluvium, Alluvial channels, Waves (Water), Beach erosion, Surf, North Carolina
Identifiers: Washover fans, Cape Hatteras.

Tidal inlets and washover fans are genetically related and dependent upon barrier configuration, depths in the lagoon adjacent to the barrier, and the direction from which storm surges come, either from the sea or the lagoon. Attack on barrier islands from the seaward side by waves overtopping the barrier will result in washover fans on wide barriers where extensive adjoining tidal flats are present. Inlets can be cut by this type attack on narrow barriers where no tidal flats are present. Storm surge from the lagoonal side, if channeled along tidal creeks, can easily cut inlets through a barrier. (Knapp-USGS)
W70-05474

SUBMARINE CANYON ORIGIN ON UPPER CONTINENTAL SLOPE OFF CAPE HATTERAS,
Atlantic Oceanographic and Meteorological Labs., Miami, Fla.
Peter A. Rona.
Journal of Geology, Vol 78, No 2, p 141-152, March 1970. 12 p, 7 fig, 2 tab, 44 ref. ONR Contract Nonr-266 (84).

Descriptors: *Canyons, *Underwater, *Erosion, *Deposition (Sediments), *Geomorphology, Ocean currents, Waves (Water), North Carolina, Sounding, Seismic studies, Hydrography, Oceanography.
Identifiers: Cape Hatteras, Submarine canyons.

The configuration of sedimentary strata revealed by continuous seismic-reflection profiles over submarine canyons on the upper continental slope off Cape Hatteras is best explained by the hypothesis of composite origin of submarine canyons. The canyons were originally incised into a post-Miocene surface of unconformity. The intercanyon areas were constructed by deposition of sediment up to several hundred meters thick forming the canyon walls while the canyons were maintained by sediment removal processes over the sites of original incision. Canyon heads are presently buried under a smooth sediment cover which extends from the shelf break at about 90 m down to about 400 m below sea level, where the canyons emerge from the cover. The depth of emergence of canyons approximately coincides with the inferred level of no motion between the northeast-flowing Florida Current and the southwest-flowing Western Boundary Undercurrent. (Knapp-USGS)
W70-05476

QUANTITATIVE ANALYSIS OF BEACH SAND MOVEMENT, VIRGINIA BEACH, VIRGINIA,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02J.
W70-05520

COMPACTNESS VARIABILITY OF ESTUARINE SEDIMENTS: AN IN SITU STUDY,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
Robert L. McMaster.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 261-267, 1967. 7 p, 7 fig, 7 tab, 11 ref. ONR Contract Nonr 396 (02).

Descriptors: *Compaction, *Estuaries, *Sediments, Sedimentation, Sands, Soil texture, Particle size, Water temperature, Pressure, Biological properties, Chemical properties.
Identifiers: Estuarine sediments.

Experimental studies reveal that regardless of season or water temperature the compaction behavior of sediments is determined by the textural and compositional properties of the particular sediment. The average slope of pressure versus time curves depends on sand content. The variation of sediment compactness with water temperature is believed to be due to subsequent changes in biological, chemical, and biochemical activities rather than the actual changes in water temperature. (Carstea-USGS)
W70-05541

OBSERVATIONS OF CIRCULATION IN COASTAL PLAIN ESTUARIES,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Donald W. Pritchard.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 37-44, 1967. 8 p, 7 fig, 10 ref.

Descriptors: *Water circulation, *Estuaries, Stratification, Classification, Model studies, Water properties, Water chemistry, Physical properties, Salinity.
Identifiers: *Estuarine circulation, Stratified estuaries.

There are 4 principal classes of coastal plain estuaries which differ in the character of circulation patterns, in the intensity of vertical stratification, and in the extent of lateral homogeneity. The character of estuarine circulation patterns is briefly described for the highly stratified, moderately stratified, and vertically homogeneous estuaries. Circulation in a highly stratified estuary is discussed for a frictionless model and in a non-tidal model. Direct observations of the distribution of chemical and physical properties, and other direct and indirect measurements are discussed. (Carstea-USGS)
W70-05542

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
For primary bibliographic entry see Field 07B.
W70-05543

GEOMORPHOLOGY AND COASTAL PROCESSES,
Cambridge Univ. (England). Dept. of Geography.
J. A. Steers.
In: Estuaries, Publication No 83, American Association for the Advancementof Science, Wash, D C, p 100-107, 1967. 8 p, 8 fig, 15 ref.

Descriptors: *Estuaries, *Coasts, Deltas, Scour, Mud, Salt marshes, Channels, Sea level, Rivers, Erosion, Waves (Water), Dredging.
Identifiers: *England, *Wales, Ribble estuary, Dee estuary, Mersey estuary, Thames estuary.

Geomorphology and coastal processes are discussed for estuaries in England and Wales. The Ribble and Dee estuaries on the west coast are rapidly becoming deltas. In contrast, natural scouring has kept the Mersey estuary open. The history of the Humber and the Wash estuaries of the east coast is traced on the basis of the work of archeologists, botanists, geographers, and historians. In both the Humber and the Wash the mud and other deposits are gradually covered by salt marsh plants. The buried channels indicate changes of the relative levels of land and sea. The Thames estuary is in a part of Britain which is slowly sinking, relative to sea level. The Thames needs constant dredging to be kept open for traffic. The influence of wind and waves upon the processes of accretion and erosion is briefly summarized. (Carstea-USGS)
W70-05544

ORIGINS OF ESTUARIES,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
Richard J. Russell.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 93-99, 1967. 7 p, 2 fig, 19 ref.

Descriptors: *Estuaries, *Tidal effects, *Tidal waters, Tides, Sea level, Ice, Glaciation, Quaternary period, Deltas, Coasts, Lakes.
Identifiers: Lake Atchafalaya, Amazon deltaic plain, Maeander Delta.

Estuaries are relatively new features of the earth's surface. The estuaries were initiated during the recent rise of the sea levels with a peak of development occurring about 3000 years ago. A taxonomic classification of estuaries is unjustified because knowledge of coastal features is incomplete. Examples of different estuaries from all over the world are given. Estuaries are headed for rapid extinction by delta formation and advancement. Lake Atchafalaya, the Amazon deltaic plain, and the Maeander Delta are discussed in order to emphasize the ephemeral nature of most estuaries. (Carstea-USGS)
W70-05545

MICROBIOLOGICAL ASSAYS OF SEA WATER USING RADIOISOTOPES-AN ASSAY FOR VITAMIN B-12 MEASURED BY C-14 ASSIMILATION,
Lamont-Doherty Geological Observatory, Palisades, N.Y.

For primary bibliographic entry see Field 02K.
W70-05546

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALTING SALINE GROUNDWATER FOR IRRIGATION PURPOSES - A CASE STUDY, BUCKEYE AREA, COLORADO RIVER BASIN, U.S.A.,
Bureau of Reclamation, Denver, Colo., Bureau of Reclamation, Nev.; and Office of Saline Water, Washington, D.C.
Harold L. Parkinson, John T. Maletic, Joseph P. Wagner, and Milton S. Sachs.
Paper presented at Symposium on Saline Water - A Valuable Resource, American Geophysical Union, Wash, D C, Apr 24, 1969. 26 p, 6 fig, 11 tab, 17 ref. Agreement No 14-01-0001-1241 USDI.

Descriptors: *Desalination, *Irrigation water, *Groundwater, Saline water, Arizona, Cost-benefit analysis, Economics, Desalination processes, Distillation, Electrodialysis, Costs, Water costs, Cost-benefit ratio, Feasibility studies.
Identifiers: Buckeye (Ariz).

A study was made of an irrigated area in Arizona to evaluate costs and benefits associated with desalting saline groundwater from seven wells as an improved water source for irrigation. Both multistage flash distillation (MSF) and electrodialysis (ED) processes were evaluated. Well water quality varied from 1,580 to 4,600 ppm. Irrigation water qualities of 400, 900, and 1,500 ppm are developed by the two processes. Benefit-cost ratios increased with improved water quality. Investment costs per acre were found to be high. The most favorable benefit-cost ratio involved utilization of the ED process at a water quality level of 400 ppm. (Knapp-USGS)
W70-05074

THE USE OF AMALGAM ELECTRODES TO MEASURE ACTIVITY COEFFICIENTS OF METAL SALTS IN MULTICOMPONENT SALT SOLUTIONS,
Tyco Labs., Inc., Waltham, Mass.
James N. Butler, and Rima Huston.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office Saline Water Research and Development Progress Report No 486, September 1969. 142 p, 28 fig, 20 tab, 62 ref. OSW Contract No 14-01-0001-607.

Descriptors: *Salts, *Desalination processes, *Research and development, Sodium chloride, Acids, Carbonates, Model studies, Ions, Selectivity, Electrodes, Computer programs, Solutes, Theoretical analysis.
Identifiers: *Activity coefficients, Amalgam electrodes, Glass electrode, Sodium bicarbonate.

The importance of activity coefficient measurements to the development and engineering of desalination processes is discussed. An outline of the research program and a list of abstracts of ten published papers resulting therefrom are given. Unpublished work carried out during the past year is described in detail, and includes measurements of the activity coefficient of NaCl in electrolytes containing sodium bicarbonate and sodium carbonate, studies of acid-base equilibria of carbonate systems in the presence of NaCl, and a theoretical analysis of the above data in terms of an ion-pairing model. Sodium selective glass electrodes are shown to give quite accurate measurements of activity coefficients for NaCl mixtures with KCl and to retain thin selectivity at high ionic strengths. The amalgam electrode method is shown to be much more accurate than glass electrode measurements in solutions containing bicarbonate. The computer programs used for calculations described in the report are given. (Carstea-USGS)
W70-05077

SOLUBILITIES OF SOME SILICATE MINERALS IN SALINE WATERS,
Bureau of Mines, Bartlesville, Okla. Bartlesville Petroleum Research Center.
For primary bibliographic entry see Field 02K.
W70-05078

ECONOMICS OF SEAWATER DESALTING IN COMBINATION WITH AMMONIA AND POWER PRODUCTION,
Bresler Chemical Engineering Associates, New York.
Sidney A. Bresler.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $3.00. Office Saline Water Research and Development Progress Report No 458, August 1969. 145 p, 22 fig, 22 tab, 18 ref, 2 append. OSW Contract No 14-01-0001-1485.

Descriptors: *Economics, *Desalination processes, *Desalination plants, Sea water, Distillation, Ammonia, Operating costs, Cost analysis, Nuclear energy, Fuels, Electric power, Natural gas.
Identifiers: *Multistage flash distillation.

The feasibility of lowering the operating cost of producing desalted water by combining its production with ammonia and electricity was examined. The cost of producing desalted water from sea water in a single-purpose multistage flash distillation (MSF) plant can be reduced almost 30% by combining its production with that of ammonia, to about 27 to 35 cents per thousand gallons in plants of capacities ranging from 12.5 to 180 MGD. The use of a common energy center permits the design of plants having a wide range of relative capacities of ammonia, desalted water and/or electric power, resulting in further possible reductions of unit water costs. The use of nuclear energy starts to become economically attractive when the cost of natural gas or other hydrocarbon fuel exceeds 25 cents per million Btu. (Carstea-USGS)
W70-05079

REVERSE OSMOSIS TUBULAR MODULE OPTIMIZATION,
Philco-Ford Corp., Newport Beach, Calif.
John L. Richardson, Gilbert Segovia, William Baerg, and Martha L. Anderson.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $2.00. Office Saline Water Research and Development Progress Report No 455, December 1969. 242 p, 86 fig, 38 tab, 35 ref. OSW Contract No 14-01-0001-1438.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, *Membrane processes, Optimization, Saline water, Temperature, Pressure, Flow rates, Salts, Reynolds number, Permeability, Costs.
Identifiers: *Tubular cellulose acetate membranes.

The permeation properties of tubular cellulose acetate membranes were measured with respect to membrane fabrication conditions, saline feed solution type and concentration level, inlet pressure, inlet temperature, inlet flow rate, surface-active feed additive concentration, and time. These membranes were most sensitive to salt type and pressure and least sensitive to salt concentration level. A model of tubular module system performance was formulated using permeation property data. The maximum performance was obtained with the smallest diameter tubes in a module designed for variable number and variable membrane tightness. Increases in integrated performance of about 20% can result in a reduction of total operating cost of more than 10%. The film theory model was found to adequately represent the variation in performance with flow rate for Reynolds numbers greater than approximately 5000. (Carstea-USGS)
W70-05080

RESEARCH ON PIEZODIALYSIS,
Ionics, Inc., Watertown, Mass.
F. B. Leitz, S. S. Alexander, and A. S. Douglas.
Available from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office Saline Water Research and Development Progress Report No 452, July 1969. 147 p, 14 fig, 72 tab, 4 append. OSW Contract No 14-01-0001-611.

Descriptors: *Desalination processes, *Membranes, *Ion transport, Ion exchange, Selectivity, Hydraulic properties, Resins, Aqueous solutions.
Identifiers: *Piezodialysis, Polyethylene membranes.

Piezodialysis is a new coupled-transport process for removing ionic constituents from an aqueous solution. The conditions under which practical piezodialysis could occur and preparation of membranes were investigated. The work was primarily directed to the study of masaic ion exchange membranes consisting of small regions of anion selective material interspersed with small regions of cation selective material. The topological, electrical, hydraulic, and electrokinetic properties of membranes were measured. Styrenized polyethylene membranes did not have the best transport properties but they were capable of withstanding application of 1500 psi pressure difference. More research is recommended for developing resins which can withstand pressure but also have good transport properties. (Carstea-USGS)
W70-05081

VACUUM FREEZING VAPOR COMPRESSION DESALTING STATE-OF-THE-ART (1968).
Hittman Associates, Inc., Columbia, Md.

Available from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price 65 cents. Office of Saline Water Research and Development Progress Report No 491, October 1969. 57 p, 16 fig, 7 tab, 17 ref.

Descriptors: *Freezing, *Vapor compression distillation, *Desalination processes, Economics, Costs, Design, Sea water, Brackish water, Scaling, Temperature, Pressure, Melting, Desalination plants.
Identifiers: *Vacuum freezing.

The state of vacuum freezing-vapor compression (VFVC) technology is evaluated and analyzed, considering process theory, design, and economic cost. The VFVC process is a feasible, reliable process for desalting brackish and sea waters. No chemical treatment is required to control scale formation. The cost of a 100,000 GPD unit operating on sea water is less than $3.00 per GPD of installed capacity. A 100,000 GPD VFVC plant is commercially available. These plants will be improved by using the direct melting concept which allows the main aspects of the desalting process to be performed in one vessel. This improvement will reduce the operating cost of the process. (Carstea-USGS)
W70-05167

THE ROLE OF DESALTING TECHNIQUES,
California Univ., Los Angeles. Water Resources Center.
Aland D. K. Laird.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p. 29-34, Dec. 1969, 6 p.

Descriptors: *Desalination, *Separation techniques, Costs.
Identifiers: Imperial Valley Project.

Desalination of water creates new water supplies and often serves a parallel need for electricity. At present, salt water is best demineralized by distillation. Such water is unnecessarily pure and can be used to dilute brackish waters to acceptable salinities, which provides important economies in the use of money and water. All methods of saline con-

version generate pure water and a waste brine. Several methods of desalination are discussed: freeze separation, electrodialysis, reverse osmosis, and distillation. The costs of these various processes are presented. Future developments are discussed. The project at Imperial Valley, California, is examined. (See W70-05276). (Grossman-Rutgers)
W70-05279

DEVELOPMENT OF HOLLOW FILAMENT TECHNOLOGY FOR REVERSE OSMOSIS DESALINATION SYSTEMS,
Monsanto Research Corp., Durham, N.C.
T. A. Orofino.
Office of Salina Water Research and Development Report No. 549, 1970, 178 p. OSW Contract 14-01-0001-1720.

Descriptors: *Desalination, *Reverse Osmosis, *Membranes, Membrane processes, Hollow fibers, Solution-spinning.

Hollow fine fibers for reverse osmosis desalination systems were prepared from cellulose acetate, other cellulose derivatives, poly (vinyl alcohol) compositions, and aliphatic polyamides. Investigation of the transport properties of these and other candidate materials in membrane form provided the required background for hollow fiber selection and preparation. A major accomplishment was the development of unique solution-spinning techniques for cellulose acetate systems which resulted in the successful translation of the Loeb skin-matrix composition to hollow fiber geometry. Performance indices established in field tests with 50 and 150 gpd modules include 4 gfd and 97% rejection on Webster, South Dakota water at 250 psi with 50% recovery. Flux stability was excellent. (Mintz-Office of Saline Water)
W70-05455

CONCEPTUAL DESIGNS OF OUTFALL SYSTEMS FOR DESALTING PLANTS,
Dow Chemical Co., Midland, Mich.
M. A. Zeitoun, W. F. McIlhenny, and R. O. Reid.
Office of Saline Water, Research and Development Progress Report No. 550, April 1970, 139 p. OSW Contract 14-01-0001-2169.

Descriptors: *Brine disposal, *Saline water, *Water pollution, Waste disposal, *Thermal pollution, Effluents, Outlets, Desalination.
Identifiers: *Marine ecology, *Effluent dispersion, Diffusers, Conceptual designs, Cost estimates, Outfall systems.

Design concepts of outfall systems from coastal desalting plants were developed based on both experimental and theoretical analyses of the dispersion of dense jets of various configurations. The modes of injection studied were: vertical submerged, vertical reaching the surface, and inclined at angles of 30 deg, 45 deg, and 60 deg from the horizontal. A computer program was developed to allow calculation of the effluent properties and flow rates from desalting plants of different sizes at different concentration factors and performance ratios for given ambient conditions. For each design case, the required dilution of copper concentration in the mixed effluent to a value of 0.02 milligrams per liter was calculated and used as the criterion for the design of the diffuser. Diffuser design charts were developed for 2, 5, 10 and 50 million gpd plants. Conceptual designs and cost estimates were made for the above four sizes of plants. (Gransee-Office of Saline Water)
W70-05456

THE MECHANISM FOR FORMATION OF 'SKINNED' MEMBRANES: I. STRUCTURE AND PROPERTIES OF MEMBRANES CAST FROM BINARY SOLUTIONS,
Hydronautics, Inc., Laurel, Md.
R. Bloch, and M.A. Frommer.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price 50 cents. Office Saline Water Research and Development Progress Report No 499, p 6-16, December 1969. 11 p, 3 tab, 6 ref. OSW Grant No 14-01-0001-1706.

Descriptors: *Desalination processes, *Membranes, *Membrane processes, Cellulose, Temperature, Porosity, Saline water, Salts, Solvents, Permeability, Selectivity, Filtration.
Identifiers: *Skinned membranes, Binary solutions, Cellulose acetate, Triethyl phosphate (T.E.P.), Dimethyl formamide (D.M.F.), Dimethyl sulfoxide (D.M.S.O.), Aceton, Dioxane.

The nature of the casting solvent used can determine the structure and desalination properties of cellulose membranes made from binary solutions. Membranes cast from acetone and dioxane are dense and structurally homogeneous. Membranes cast from T.E.P. are also structurally homogeneous but porous, and do not reject salt. 'Skinned' membranes consisting of a dense cellulose acetate layer supported by a porous substructure were obtained from acetic acid, D.M.F. or D.M.S.O. The skin forms at the air-cast-solution interface when acetic acid is used as the solvent. When D.M.F. or D.M.S.O. are used as solvents, the skin is located at the supported interface. The porosity of cellulose acetate membranes decreases considerably when annealed at temperatures higher than 90 deg C. (See also W70-05514). (Carstea-USGS)
W70-05513

THE MECHANISM FOR FORMATION OF 'SKINNED' MEMBRANES: II. EQUILIBRIUM PROPERTIES AND OSMOTIC FLOWS DETERMINING MEMBRANE STRUCTURE,
Hydronautics, Inc., Laurel, Md.
M. A. Frommer, I. Feiner, O. Kedem, and R. Bloch.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price 50 cents. Office Saline Water Research and Development Progress Report No 499, p 17-33, December 1969. 4 fig, 1 tab, 20 ref. OSW Grant No 14-01-0001-1706.

Descriptors: *Desalination processes, *Membranes, Membrane processes, Osmosis, Osmotic pressure, Flow, Cellulose, Solvents, Equilibrium.
Identifiers: *'Skinned' membranes, *Cellulose acetate membrane.

The critical water concentrations required to initiate the precipitation of cellulose acetate from 20% solutions in acetone, acetic acid, triethyl phosphate, dimethyl formamide and dimethyl sulfoxide have been measured. The direction and magnitude of flow through a porous cellulose acetate membrane was also determined. The concentration of nonsolvent required for precipitating cellulose acetate and the direction and magnitude of osmotic flows correlated with the volume concentration of the polymer at the precipitation point. A mechanism is suggested to explain the direction and magnitude of flows based on the formation of each membrane layer. (See also W70-05513). (Carstea-USGS)
W70-05514

MULTISTAGE FLASH DISTILLATION DESALTING STATE-OF-THE-ART (1968).
Hittman Associates, Inc., Columbia, Md.

Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.25. Office of Saline Water Research and Development Progress Report No 490, October 1969. 138 p, 40 fig, 24 tab, 48 ref.

Descriptors: *Desalination plants, *Desalination processes, *Distillation, Evaporation, Design, Costs, Cost analysis, Evaporators, Economics, Desalination plants.
Identifiers: Multistage flash distillation.

The design and economics of multistage flash desalting plants utilized in both single and dual purpose modes of operation over a range from 1 to 150 MGD were evaluated. Multistage flash evaporation plants can currently be built with performance ratios in excess of 14 pounds of product water per 1000 Btu's of heating steam. However, at present technological levels, performance ratios of about 9-11 pounds per 1000 Btu result in minimum water cost. About 40-60% of the installed plant capital cost is related to the evaporator tube bundles and shell. Most of the future reductions in water cost from the MSF process will come from improvements in material and process design. (Carstea-USGS)
W70-05515

PRELIMINARY PROCESS DEVELOPMENT STUDIES FOR DESULFATING GREAT SALT LAKE BRINES AND SEA WATER,
Bureau of Mines, Salt Lake City, Utah. Salt Lake City Metallurgy Research Center.
D'Arcy R. George, J. M. Riley, and Laird Crocker.
Bureau of Mines Report of Investigations 6928, 1967. 34 p, 11 fig, 13 tab, 8 ref.

Descriptors: *Water chemistry, *Brines, *Sulfates, *Great Salt Lake, Chemical precipitation, Salinity, Mineral industry, Water utilization, Natural resources, Saline water, Water resources development.
Identifiers: Sulfate removal, Brine mineralogy.

A process developed for removing sulfate from Great Salt Lake brines and other natural brines, including sea water is described. Sulfate is quantitatively removed by precipitation as barium sulfate in a cyclic process employing ion-exchange techniques. Barium is continuously recovered and recycled, and sodium carbonate and sulfur or sulfuric acid are produced as byproducts in quantities sufficient to more than defray the cost of desulfation. This process has favorable economic benefits which could lead to significant cost reduction in producing fresh water from sea water. (Lang-USGS)
W70-05536

3B. Water Yield Improvement

EVAPORATION NORMS FROM WATER RESERVOIRS,
State Hydrological Inst., Moscow (USSR).
For primary bibliographic entry see Field 02D.
W70-05056

A STUDY OF THE EFFECTS OF WAVES ON EVAPORATION FROM FREE WATER SURFACES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
For primary bibliographic entry see Field 02D.
W70-05208

THE SILVER IODIDE GENERATOR AND PUBLIC HEALTH,
Bureau of Reclamation, Denver, Colo.
William J. Douglas.
Preprint 1060, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 16 p, 14 ref, 2 append.

Descriptors: *Silver iodide, Cloud seeding, *Toxicity, *Safety, Carbon monoxide, Lead compounds, Potable water, Air pollution, Water pollution, Automobiles, Concentration, Nitrogen compounds, *Health, *Public health, Atmospheric precipitation, Hazards, Adsorption, *Weather modification.
Identifiers: *Silver iodide generators, Toxicants, Public Health Service, Iodide, Acetone, Exhaust gases.

Exposure of the operator of a cloud seeding generator is compared with threshold limits for prolonged exposure established by the American

Conference of Governmental Industrial Hygienists. For silver iodide and its complexes, iodine and carbon monoxide, maximum exposure was below hazardous levels. Concentrations of silver and iodine in precipitation from seeded storms were below permissible levels set by the US Public Health Service for drinking water. The inoffensive nature of the effluent from a silver iodide generator is emphasized by contrasting its chemical content with that of automobile exhaust. (USBR)
W70-05211

STATISTICAL EVALUATIONS OF A CLOUD-SEEDING PROGRAM AT THE STREAMFLOW CONTROL LEVEL,
Washington State Univ., Pullman; and State of Washington Water Research Center, Pullman.
For primary bibliographic entry see Field 02A.
W70-05221

CROP RESPONSES TO RAINFALL MULTIPLIERS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
H. D. Wittmuss, and P. L. Ehlers.
American Society of Agricultural Engineers, Transactions, Vol 11, No 4, p 484-486, July-August 1968. 1 fig, 4 tab, 7 ref.

Descriptors: *Water harvesting, *Water utilization, *Crop response, *Irrigation efficiency, *Semiarid climates, Great Plains (Nebr), Sorghum, Wheatgrass, Crop production, Soil-water-plant relationships, Rainfall, Bench leveling, Slopes, Water yield improvement.
Identifiers: *Rainfall multipliers, *Sealed contributing areas.

In a study of water-use efficiency in a semiarid area of Nebraska, rainfall multipliers were installed. They consisted of sealed contributing areas on a 3% slope above level bench areas. The increased available water was used on grain sorghum and intermediate wheatgrass plots. With 100, 150, 200, and 250 percent of rainfall availability, the sorghum plots yielded 3.9, 3.6, 3.2, and 2.8 bu per acre-inch of water, respectively (1963). The grain yield was highest on the 150 percent plot. With 100, 150, 200, and 250 percent of rainfall availability, the wheatgrass plots yielded 130, 140, 171, and 148 lb of hay per acre-inch of water, respectively (1964-66). In 1966 irrigated plots of wheatgrass produced 50 percent more hay than any rainfall multiplier plot during the three-year period. However, the plots receiving 200 percent rainfall in 1965 produced as much hay per unit of water as the irrigated plots. Further studies are needed to improve water harvesting and efficient water utilization in semiarid areas such as the Great Plains. (Carr-Arizona)
W70-05296

EVAPORATION AND ITS SUPPRESSION BY CHEMICAL FILMS AT LAKE HEFNER,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
F. R. Crow, J. B. Allen, W. E. Fry, and A. L. Mitchell.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 889-895, 898, November-December 1969. 8 fig, 6 tab, 12 ref.

Descriptors: *Evaporation control, *Monomolecular films, *Hydrologic budget, *Energy budget, *Heat transfer, Mass transfer, Reservoir evaporation, Evaporation, Chemcontrol, Films, Hexadecanol, Octadecanol, Water conservation, Lakes, Instrumentation, Data collections, Wind velocity, Rates of application, Equations, Water temperature.
Identifiers: *Lake Hefner (Okla).

The purpose of the Lake Hefner experiments was to determine the relation between the energy budget and water budget methods of computing evaporation, determine heat and mass transfer coefficients for the lake, and investigate the effectiveness of monolayer-forming chemicals in reducing evaporation when applied continuously to a large lake by stationary application. Results were: (1) The evaporation studies showed that, if the water budget method were considered as standard, the energy budget method over-estimated lake evaporation. (2) Heat transfer coefficient K was computed as 1.82 cal per sq cm day mph deg C for the water budget method and 2.27 for the energy budget method. (3) Hexadecanol-octadecanol slurry was applied to the lake by a floating sprinkler system and an average film cover of 25% was achieved. It appears, however, that degree of evaporation reduction cannot be accurately measured using existing techniques. (Carr-Arizona)
W70-05300

PARK RANGE: ATMOSPHERIC WATER RESOURCES PROGRAM,
EG and G, Inc., Boulder, Colo., Environmental Services Operation.
J. O. Rhea, P. Willis, and L. G. Davis.
Available from the Clearinghouse as PB-188 596, $3.00 in paper copy, $0.65 in microfiche. Final rept., 30 Sep 69, 388 p. Bureau of Reclamation, Contract DI-14-06-D-5640.

Descriptors: *Artifical precipitation, *Cloud seeding, *Silver iodide, *Weather modification, Nucleation, Freezing, Mountains, Radiosondes, Snow, Winds, Air, Temperature, Clouds, Instrumentation, Feasibility.
Identifiers: Park Range (Colorado), Site selection.

The procedures and results of a five-year program of cloud seeding to increase orographic precipitation in the Park Range of Colorado are presented. Winter precipitation systems were seeded with silver iodide from ground generators and aircraft. Measurements in the seeding target area included: total snowfall, snowfall rate, freezing nuclei counts, type of snow crystals, and concentration of silver in snow, as well as radar and rawinsonde observations. As part of the investigation, diffusion tests were conducted to study the transport and dispersion of seeding agent, and a numerical model was developed to predict location and rate of snowfall as functions of observed wind, temperature, and stability.
W70-05317

3C. Use of Water of Impaired Quality

DESALTING SALINE GROUNDWATER FOR IRRIGATION PURPOSES - A CASE STUDY, BUCKEYE AREA, COLORADO RIVER BASIN, U.S.A.,
Bureau of Reclamation, Denver, Colo., Bureau of Reclamation, Nev.; and Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-05074

PHYSIOLOGICAL RESPONSE OF PLANTS TO SALINITY AND HUMIDITY,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 02I.
W70-05119

FEASIBILITY STUDY FOR GLENDALE - LOS ANGELES WATER RECLAMATION PLANT (CONDENSATION),
Engineering Science, Inc., Oakland, Calif.; and Koebig and Koebig, Inc., Los Angeles, Calif.
R. J. Theroux, and Robert L. White.
March 1969. 24 p, 4 fig.

Descriptors. *Water reuse, *Water pollution treatment, *Waste water, *Waste water treatment, *Water purification, *Beneficial use, *Reclaimed water, Industrial water, Planning.
Identifiers: *Los Angeles, *Glendale, *Water reclamation plant, *Hyperion Treatment Plant.

In March, 1968, the Cities of Glendale and Los Angeles entered into an agreement to conduct a study to determine the feasibility of constructing a joint water reclamation plant in the Glendale area. Engineering Services, Inc. and Koebig and Koebig, Inc. were retained to perform the engineering services. The comprehensive report concluded that it is necessary, and technically and economically feasible, to build and operate the plant through a joint-powers agreement. The proposed plant, designed for a capacity of 20 mgd in its initial stage, is to be built in 1970. Enlargement of the plant to 35 mgd is proposed for 1987. The final stage, to be completed in 1995, will bring the capacity up to 50 mgd. The plant will be constructed on 15 acres of Glendale property that is currently a community eyesore. Wastewater taken from trunk sewers will receive primary and secondary treatment. The reclaimed water will be sparkling clear and will be suitable for use in irrigation, industrial cooling, fire fighting, et cetera. Solid wastes will be removed and put back into the sewer, for processing at the Hyperion Wastewater Treatment Plant. The initial cost is estimated at $5.60 million with the corresponding cost per acre foot estimated between $29 and $32. This unit cost will decrease as the plant capacity is increased, so that by the year 2025 the unit costs of the reclaimed water should be about $19 per acre foot. Federal assistance under Public Law 660 appears promising. (Poertner-Chicago)
W70-05254

CONVENTIONAL AND ADVANCED WASTE TREATMENT,
Los Angeles County Sanitation District, Calif.
John D. Parkhurst.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p. 16-28, Dec. 1969. 13 p, 2 tab, 1 map.

Descriptors: *Sewage treatment, *Tertiary treatment, *Water reuse, Costs, Demineralization, Anion exchange, Electrodialysis, Osmosis.

Waste water is generated within Los Angeles County at the rate of 700 million gallons per day. This waste water is an untapped supply of additional water. Water reclaimation and reuse has been continuing since 1949. Direct recharge of groundwater basins by spreading has been occurring as a natural adjunct of water treatment for many years. Such treatment of effluents meet health requirements. The sanitation districts' master plan is presented. Advanced waste treatment, or tertiary treatment, starts with secondary effluent and improves or tailors the quality of the water for some specific purpose. Two forms of secondary effluent removal are filtration and microstraining. Different methods of the removal of nutrients, such as phosphate, ammonia and nitrate, are given. Other aspects of secondary water treatment discussed are carbon absorption, demineralization, reverse osmosis, ion exchange, and electrodialysis. Data on water quality characteristics that result from demineralization processes are presented, as well as the costs of these processes. (See W70-05276). (Grossman-Rutgers)
W70-05277

TECHNICAL PROBLEMS CREATED BY REUSE,
California Univ., Berkeley. Sanitary Engineering Research Lab.
P. H. McGauhey.
Report No. 16, Univ. of Calif., Los Angeles, Calif. Water Resources Center, p 35-38, Dec. 1969. 4 p, 1 fig.

Descriptors: *Water reuse, *Separation techniques, Feasibility, Water quality.

Man must decide which tasks of water reuse he must undertake and which he leaves to nature. Man

must consider the technical problems created by reuse of water. Two alternate possibilities of solids management are presented in a diagram. Their particular technical problems are discussed. Systems problems are the technological problems of economically producing dry solids. Problems of type of use are presented with respect to agriculture and industrial use, and to municipal. Some problems are particular to the city. Finally, there is a problem of delivering reused waters. (See W70-05276). (Grossman-Rutgers)
W70-05278

DEPTH OF DRAINAGE IN IRRIGATED AREAS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 02G.
W70-05292

3D. Conservation in Domestic and Municipal Use

REPORT UPON ADEQUATE WATER SUPPLY FOR THE CHICAGO METROPOLITAN AREA--1969 TO 2000,
Alvord, Burdick and Howson, Chicago, Ill.
For primary bibliographic entry see Field 06D.
W70-05255

3E. Conservation in Industry

EFFECTS OF PUMPING FROM THE OHIO RIVER VALLEY ALLUVIUM BETWEEN CARROLLTON AND GHENT, KENTUCKY,
Geological Survey, Louisville, Ky.
For primary bibliographic entry see Field 04B.
W70-05506

3F. Conservation in Agriculture

EFFICIENCIES OF AN AUTOMATED SURFACE IRRIGATION SYSTEM WITH AND WITHOUT A RUNOFF RE-USE SYSTEM,
Nebraska Univ., Lincoln.
P. E. Fischbach, and B. R. Somerhalder.
Paper 69-716, Amer Soc Agr Eng 1969 Winter Meet, Chicago, Ill, Dec 1969. 12 p, 1 fig, 4 tab, 8 ref.

Descriptors: Irrigation, *Irrigation efficiency, *Water reuse, Runoff, Surface irrigation, *Uniformity coefficient, *Automatic control, *Remote control, Furrow irrigation, *Irrigation systems, Furrows, Soil moisture, Application methods, Nebraska, Experimental farms, Field tests.
Identifiers: *Water application rate, Irrigation advance, Reuse.

An automated surface irrigation system with a reuse feature was developed at the University of Nebraska field laboratory at Mead to determine the efficiencies of the system with and without reuse. Specific objectives were to determine: (1) the water application efficiencies, and (2) the water uniformity coefficient of an automated surface irrigation system. An automatic surface irrigation system with a reuse feature is an efficient method of applying irrigation water (91.9% water application efficiency) because the feature eliminates labor needed to use cutback furrow stream. Uniform water application can be accomplished (91.8% water uniformity coefficient) by designing the distribution system to apply a furrow stream 3 times the basic intake rate. The system should be designed not to exceed the maximum allowable furrow stream size--the furrow stream size selected should not cause serious erosion. Good correlation was found between the water uniformity coefficient measured by soil moisture sampling and the coefficient measured by using electrical resistance blocks. (USBR)
W70-05231

SEASONAL VARIATION OF HYDRAULIC PARAMETERS AND THEIR INFLUENCE UPON SURFACE IRRIGATION APPLICATION EFFICIENCY,
North Dakota State Univ., Fargo; and Rock Island Arsenal, Ill.
Charles L. Linderman, and Earl C. Stegman.
Paper 69-715, Amer Soc Agr Eng 1969 Winter Meet, Rock Island Arsenal, Ill.

Descriptors: Application methods, Infiltration, Soil moisture, Slopes, Rates of application, *Surface irrigation, *Irrigation efficiency, Field investigations, Irrigation, Farm units, Flow rates, Percolation, Runoff, Mannings equation, *Irrigation practices, Flow characteristics, Computer programming, *Seasonal, Flow resistance, Effects.
Identifiers: *Seasonal variations, Irrigation advance, Flow patterns, Infiltration rate, USBR research contracts.

An investigation was made to observe and characterize the seasonal hydraulic behavior of an irrigated farm unit. The study, conducted in 2 parts, included: (1) a field investigation to observe and characterize the seasonal hydraulic behavior of the irrigated unit, and (2) an analysis of the relative influence of several parameters on water application efficiency. By using a standard set of conditions, the relative influences of infiltration rate, retardance coefficient, soil moisture deficit, slope, and length of run on application efficiencies were studied. A computer program was used for calculating the advance and recession curves to estimate the volumes of water applied, stored, and lost to deep percolation or runoff. The analyses indicated that near-equal levels of application efficiency are attainable over a wide range of conditions. The relative influences of intake rate, border length, slope, roughness, and soil moisture deficit on application efficiency are demonstrated. (USBR)
W70-05235

ESTIMATING THE PRODUCTIVITY OF IRRIGATION WATER,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 06B.
W70-05282

THE CLIMATOLOGY OF SOIL MOISTURE, EVAPORATION, AND NON-MOISTURE STRESS DAYS FOR CORN IN IOWA,
Environmental Science Services Administration, Rockville, Md.; and Iowa State Univ., Ames.
For primary bibliographic entry see Field 02D.
W70-05286

APPLICATION RATES AND RUNOFF IN CENTER-PIVOT SPRINKLER IRRIGATION,
Colorado State Univ., Fort Collins. Dept. of Agricultural Engineering.
D. C. Kincaid, D. F. Heermann, and E. G. Kruse.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 790-794, 797, November-December 1969. 6 p, 9 fig, 4 tab, 4 ref.

Descriptors: *Rates of application, *Application methods, *Sprinkler irrigation, *Runoff, *Soil types, Irrigation systems, Irrigation practices, Irrigation design, Irrigation efficiency, Slopes, Soil surfaces, Estimating, Data collections, Consumptive use, Soil water, Discharge (Water), Infiltration.
Identifiers: *Center-pivot sprinkler systems, *Soil intake rates, *Potential runoff, *Actual runoff.

Application rates and expected runoff in relation to different soil types were analyzed for the center-pivot sprinkler irrigation system. Potential runoff theory using modified experimental intake constants was applied to field situations. Results were compared with experimental estimates of actual runoff. Given a certain amount of potential runoff from a particular area, actual runoff depends on slope, roughness of soil surface, and position with respect to other runoff areas. Special attention should be given to soil surface conditions and intake rates when applying center-pivot systems to sloping lands. (Carr-Arizona)
W70-05288

EFFECT OF SOIL PROFILES ON MOVEMENT OF WATER ON SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02G.
W70-05291

A HYDRODYNAMIC DETERMINATION OF CUTBACK STREAM SIZES FOR IRRIGATION FURROWS,
Florida Univ., Gainsville. Dept. of Agricultural Engineering.
O. C. Wilke, and E. T. Smerdon.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 634-637, September-October 1969. 11 fig, 10 ref.

Descriptors: *Hydrodynamics, *Flow, *Furrows, *Furrow irrigation, *Irrigation engineering, Irrigation design, Channels, Streamflow, Runoff, Water management (Applied), Equations, Water loss, Infiltration, Mathematical models, Volume, Wetting, Application methods.
Identifiers: *Cutback, *Cutback sizes, Steady state.

In order to avoid runoff losses, the stream should be reduced after the wetting front nears or reaches the end of the furrow. Two methods of determining the required cutback size are volume balance analysis and numerical integration of the steady state equations of motion for shallow flow. These two methods were studied and graphic design relationships presented. Good field verification of the volume balance method was achieved, but more experimentation should be conducted. It would then be possible to design an automated cutback system which could apply water uniformly without runoff losses. (Carr-Arizona)
W70-05295

CROP RESPONSES TO RAINFALL MULTIPLIERS,
Nebraska Univ., Lincoln. Agricultural Experiment Station.
For primary bibliographic entry see Field 03B.
W70-05296

PLASTIC ORIFICE INSERTS FOR SUBSURFACE IRRIGATION,
Massachusetts Univ., Amherst. Dept. of Agricultural Engineering, and Office of Water Resources Research, Washington, D.C.
L. F. Whitney, and K. M. Lo.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 602-604, 607, September-October 1969. 4 p, 3 fig, 6 tab, 4 ref. WR-15, 1966 and Agway, Ind. 1967 and 1968.

Descriptors: *Subsurface irrigation, *Irrigation design, *Plastics, *Orifices, *Pipes, Flow rates, Equipment, Irrigation systems, Nozzles, Orifice flow, Pipe flow, Porous media, Application methods, Costs, Design, On-site tests, Tubes, Water distribution (Applied).

Economies in water use, plus advantages of liquid fertilizer and herbicide injection, have made subsurface irrigation the object of much study. Research has shown that the major problem of using plastic pipe for underground irrigation networks lies in developing a discharge orifice that resists clogging from internal water impurities and external soil particles. Three orifice designs were investigated: porous media, in-wall orifices protected by labyrinths, and plastic insert orifices. Results of the study were disappointing for porous media and in-wall orifice designs, the latter being completely unreliable. A plastic insert orifice was designed which featured uniform water distribution, easy installation, and low manufacturing cost. (Carr-Arizona)
W70-05297

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
L. Joe Glass.
American Society of Agricultural Engineers, Transactions, Vol 12, No 5, p 642-645, September-October 1969. 4 fig, 1 tab, 12 ref.

Descriptors: *Open channels, *Channels, *Irrigation canals, *Irrigation design, *Canal design, Design, Canals, Open channel flow, Cohesive soils, Depth-area curves, Soil properties, Tractive forces.
Identifiers: *Channel design, Design curves.

Empirical methods are generally employed in the design of open irrigation channels, since considerable engineering judgement is made necessary by variations in the properties of earth materials through which the channels are constructed. The theoretical approach to channel design has been studied but is not widely accepted. A theoretical procedure is presented here for designing stable open channels through cohesive soils. Design curves are developed and an example is included. Design curves may be obtained from the author. (Carr-Arizona)
W70-05298

MARGINAL VALUE OF IRRIGATION WATER AND A CASE STUDY OF TRANSFER IN SOUTHEASTERN WYOMING,
Wyoming Agricultural Experiment Station, Laramie.
J. N. Sorensen, and R. T. Clark.
Available from the Clearinghouse as PB-190 803, $3.00 in paper copy, $0.65 in microfiche. Agricultural Experiment Station, University of Wyoming Research Bulletin No. 511, January 1970. 42 p, 12 tab, 27 ref, 3 append. OWRR Project A-001-WYO.

Descriptors: *Marginal utility, *Water transfer, *Irrigation efficiency, *Return flow, Marginal benefits, Water rights, Marginal costs, Evaluation, Irrigation districts, Irrigation effieiency, Irrigation water.
Identifiers: *Marginal value, Wheatland Irrigation District, Ringsby Ranch.

The main objective of study was to provide economic information to aid decision-makers re: transfer of water rights between two types of agricultural users. Specific objectives were: (1) to present the legal environment for transfer; (2) to estimate marginal value of water to a farmer raising row crops; and (3) to estimate marginal value of water to a farmer or rancher who produces native hay. The area chosen for the analytical portion of the study was the Wheatland Irrigation District and its holdings, the Ringsby Ranch. The irrigation district is at an elevation ranging from about 4700 to 5000 feet. Ringsby Ranch elevation ranges from 7000 to 75000 feet above sea level. Data was obtained from personal interviews and from available secondary sources. Budgeting was used to develop input coefficients for use in linear programming models. Marginal value of water was estimated at various water levels for five different farm and ranch models. In analyzing transfer, it was assumed that one-half of purchased water would have to remain at place of origin to satisfy return flow requirements. Also it was assumed that there would be 50% delivery efficiency from Ringsby Ranch to the Wheatland farms. Findings indicate that transfer of water right would generally be economic where amount supplied to farms did not exceed 1.5 feet per acre. Marginal values of water ranged from nearly $20.00 per acre foot, on a farm having livestock, to less than $5.00 for a crop farm with no sugar beets. In this latter instance, transfer is found to be uneconomic, for transfer costs are estimated at $5.00 per acre foot. The main conclusion of the study is that water transfer between irrigators has some basis in terms of providing more returns from a given quantity of water at least on a yearly basis. More transfers would likely take place if the institutional arrangement unquestionably permitted transfer. Further study is needed to be more definite concerning permanent sale or transferof rights. It also can be concluded that before the marginal value of water for individual crops can be determined, physical studies with varying levels of water need to be conducted. (Rechard-University of Wyoming)
W70-05462

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

TEST OF NOURISHMENT OF THE SHORE BY OFFSHORE DEPOSITION OF SAND, LONG BRANCH, NEW JERSEY,
Army Coastal Engineering Research Center, Washington, D.C.
J. V. Hall, and W. J. Herron.
Available from the Clearinghouse as PB-101 026, $3.00 in paper copy, $0.65 in microfiche. Technical Memo., June 1950, 36 p., Rept. no. TM-17.

Descriptors: *Beaches, Erosion, *Sand, Deposition, Reaction, Construction, Hydrographic surveying, Tides, Ocean waves, Harbors, Piers, New Jersey.
Identifiers: Dredging, Long Branch (N J), Beach erosion.

The paper presents results of a study to test the feasibility of nourishing eroded shores with dredge spoil.
W70-05111

UNSTEADY FLOW OF DILUTE AQUEOUS POLYMER SOLUTIONS IN PIPE NETWORKS-A METHOD TO IMPROVE WATER DISTRIBUTION,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
For primary bibliographic entry see Field 08A.
W70-05120

FLOOD PLAIN INFORMATION - CANYON CREEK AT JOHN DAY AND CANYON CITY, OREGON.
Corps of Engineers, Walla Walla, Wash.

Corps Engineers Flood Plain Report, May 1969. 28 p, 5 fig, 7 plate, 1 tab.

Descriptors: *Floods, *Flood damage, *Oregon, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: John Day (Oreg), Canyon City (Oreg), Standard project flood, Intermediate regional flood.

Flooding of Canyon Creek, John Day and Canyon City, Oregon is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05171

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, CUYAHOGA AND SUMMIT COUNTIES, OHIO.
Corps of Engineers, Buffalo, N.Y.

Corps Engineers Flood Plain Report, September 1969. 47 p, 22 fig, 13 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Ohio, *Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cuyahoga River (Ohio), Standard project flood, Intermediate regional flood.

Flooding of the Cuyahoga River, Ohio is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05172

AN EVALUATION OF RADAR IMAGERY AS A TOOL FOR DRAINAGE BASIN ANALYSIS,
Kansas Univ., Lawrence. Dept. of Geography.
For primary bibliographic entry see Field 07B.
W70-05180

FLOOD PREVENTION AND DAMAGE REDUCTION.
Nebraska Soil and Water Conservation Commission, Lincoln.
For primary bibliographic entry see Field 06F.
W70-05187

HYDRAULICS OF STRATIFIED FLOW - SECOND PROGRESS REPORT SELECTIVE WITHDRAWAL FROM RESERVOIRS,
Bureau of Reclamation, Denver, Colo.
D. L. King.
Bur Reclam Rep Hyd-595, Sept 1969. 54 p, 17 fig, 4 tab, 24 ref, append.

Descriptors: Research and development, Reservoirs, Reviews, *Hydraulic models, Density currents, Hydraulics, Water quality, Temperature, Froude number, *Stratification, Velocity distribution, *Thermal stratification, Theory, Bibliographies, Design criteria, *Stratified flow.
Identifiers: *Multilevel outlets, *Selective level releases, Progress reports.

Selective outlet works for reservoirs provide an important control for maintaining water quality in the downstream river. The use of multilevel outlets is growing, but design guidelines are seriously lacking. A study of previous theoretical and experimental work in selective withdrawal from reservoirs shows that a basis exists for development of practical design and operating criteria. Beginning with the theory for selective withdrawal from a continuously stratified fluid, a method is developed for the more general density profile. The method is verified with experimental data. Limitations of the method and the need for further experimental verification with model and prototype data are discussed. (USBR)
W70-05251

FACTORS AFFECTING GROWTH OF ROOTED AQUATIC PLANTS IN A RESERVOIR,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-05260

SUMMARY OF LITERATURE ON AQUATIC WEED CONTROL,
Toronto Univ. (Ontario).
For primary bibliographic entry see Field 05C.
W70-05263

LEVEE AND DRAINAGE DISTRICTS (CERTAIN INTERNAL IMPROVEMENTS).

Iowa Code Ann secs 455.148-455.150 (1949).

Descriptors: *Drainage districts, *Levees, *Iowa, *Obstruction to flow, Tile drains, Root systems, Shrubs, Trees, Right-of-way, Legislation, Administration, Ditches, Laterals, Legal aspects, Condemnation, Outlets, Assessments, Costs.

The Board of Supervisors of a drainage district shall have any obstructions, which interfere with the flow of water, removed from the ditches of the district. Any tile drain so obstructed may be relaid. Costs of all such work are to be paid from drainage funds of the district. It may become necessary to destroy trees or hedges outside the right-of-way of any ditch in order to prevent obstruction by the roots thereof. If the Board and the owners of such trees or hedges cannot agree on the damage for the destruction thereof, the Board may move to acquire the right to destroy the trees or hedges. This should be done in the same manner in which the right-of-way was acquired. The owner of any premises assessed for costs of a drainage system shall have the right to use the same as an outlet for lateral drains from his premises. The Board shall promulgate specifications covering the manner of connection of such lateral drains and their maintainance. The owner shall comply with these specifications. (Cuevas-Florida)
W70-05303

RURAL WATER DISTRIBUTION SYSTEMS: AN ANALYSIS OF CREATING A LOCAL SYSTEM,
For primary bibliographic entry see Field 06E.
W70-05341

ILLINOIS DRAINAGE CODE (SUBDISTRICTS).
Ill Ann Stat, ch 42, secs 7-1 thru 7-12, (Smith-Hurd), as amended, (Supp 1970).

Descriptors: *Illinois, *Drainage districts, *Drainage systems, *Drainage programs, Administrative agencies, Soil conservation, Civil engineering, Construction, Surveys, Assessments, Cost allocation, Drains, Outlets, Project planning, Administration, Decision making, Legal aspects.
Identifiers: *Subdistricts.

Drainage districts may be divided into subdistricts for the purpose of providing more complete drainage or protection of lands within the proposed subdistrict. Administrative procedure is provided for the establishment of subdistricts by the drainage district commissioners. Any subdistrict so organized shall be a body politic and shall have all the powers of a main district. The commissioners for the main district shall also serve as commissioners for any subdistrict. Minor subdistricts may be organized within subdistricts following this same procedure. (Dearing-Florida)
W70-05350

LEVEE DISTRICTS (ORGANIZED BY CIRCUIT COURT).

Mo Ann Stat secs 245.030 thru 245.085 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Jurisdiction, *Levees, Land tenure, Land, Legislation, Taxes, Benefits, Assessments, Land reclamation, Administration, Leadership, Legal aspects, Political aspects, Governments, State governments, Local governments, Financing.
Identifiers: *Levee districts.

Upon petition to the circuit court, any two or more adjacent levee districts may consolidate. The Board of Supervisors of each district shall file such petition, and any landowner in either of the districts may file objections. New districts shall be subject to all the rights and obligations outlined in this chapter. The corporate life of a district may be extended in order to complete works and perform obligations. Levee districts may reorganize pursuant to this chapter, and all reorganized districts shall be entitled to the benefits herein provided. This chapter also provides for: hearing procedures, election of boards of supervisors, annual reports, annual meetings, and control of district records and money. (Duss-Florida)
W70-05360

SANCO SALES, INC., V MASSACHUSETTS BAY TRANSPORTATION AUTHORITY (LIABILITY FOR DIVERSION OF RAIN WATER).

252 N E 2d 214-215 (Mass 1969).

Descriptors: *Massachusetts, *Cloudbursts, *Diversion structures, *Flood damage, Judicial decisions, Surface runoff, Floods, Overland flow, Precipitation excess, Rain water, Repulsion (Legal aspects), Storm runoff, Surface waters, Surface drainage, Barriers, Check structures, Retaining walls, Obstruction to flow, Flood protection, Flash floods, Rain, Water injury, Alteration of flow, Relative rights, Legal aspects.

To prevent the inundation of an underground streetcar station during a series of long rainstorms, defendant transportation authority erected two farriers across its tracks between two retaining walls. Plaintiff suffered water damage to his personal property when surface water produced by the rains flowed along the streetcar property and into an area between a retaining wall and plaintiff's building. Plaintiff sued in tort, and the trial judge directed a verdict for defendant. The appellate court found no error, and held that the barriers were erected by defendant on its property in exercise of its right to divert surface waters from the property. Defendant has this right irrespective of the possibility of harm to nearby property, absent a showing of negligence or trespass. (Douberley-Florida)
W70-05367

FORMATION AND PURPOSES OF DRAINAGE DISTRICTS.
Mo Ann Stat secs 243.010 thru 243.070 (1952).

Descriptors: *Missouri, *Drainage districts, *Ditches, *Drains, Bank protection, Levees, Land tenure, Public health, Construction, Streams, Lakes, Banks, Erosion, Navigable waters, Federal government, Financing, Planning, Costs, Legislation, Water levels, Legal aspects, Project planning, Projects, Watercourses (Legal).

As used in this chapter the word ditch shall include drains, watercourses, bank protections, current controls and levees. In the interest of public health and welfare and to effect necessary construction in order to protect land or other property the county court has authority to organize and establish drainage districts. Such improvements may include branch ditches, the lowering of lake levels, and protection of stream banks from erosion. When work is done on navigable streams, consent shall first be obtained from the federal government. Before the establishment of any drainage district, at least one affected landowner shall file a petition stating its necessity, proposed boundaries, and the names of landowners within the proposed districts' boundaries. The county court shall appoint counsel to assist in the establishment of the district. The court shall appoint an engineer to determine the necessity for the improvements and to indicate their dimensions, location and probable costs. The engineer shall also determine if any lands adjacent to the district will be benefited. Hearings on the engineers' determination shall be held and interested parties may object to such improvements. (Duss-Florida)
W70-05418

PROCEDURE FOR DISSOLUTION OF LEVEE DISTRICTS.
Mo Ann Stat secs 245.270 thru 245.280 (1959).

Descriptors: *Missouri, *Levees, *Flood control, Legal aspects, Legislation, Taxes, Organizations, Administrative agencies, Cost allocation, Financing, Drainage systems, Management, Jurisdiction, Supervisory control (Power).

Circuit courts may dissolve levee districts when the owners of a majority of the land acreage petition for dissolution. Before dissolving a district, the circuit court must ascertain and determine that all debts, warrants, and obligations of the district have been paid. If a district is unable to meet financial obligations from existing assets, the court will direct the board of supervisors of the levee district to levy and collect a uniform tax to satisfy these obligations before dissolution will be permitted. The repeal of existing laws does not affect existing rights of levee districts. (Casey-Florida)
W70-05436

POWERS OF LEVEE DISTRICTS.
Mo Ann Stat secs 245.225 thru 245.265 (1959).

Descriptors: *Missouri, *Levees, *Costs, *Administration, Legal aspects, Administrative agencies, Flood protection, Bodies of water, Legislation, Taxes, Tax rate, Assessments, State governments, Inspection, Control, On-site investigations, Regulation, Flood control, Supervisory control (Power).
Identifiers: Penalties (Criminal).

Any levee district may institute an action against the record owner of real property to enforce collection of delinquent assessments. Unpaid assessments become a lien on the property. Authority is granted to the board of supervisors of each levee district to issue bonds, levy taxes, and issue warrants for payment of maturing bonds. Funds from the sale of bonds may only be used for paying the cost of the levee works, improvements, expenses, fees, and district salaries. The board of supervisors may appoint inspectors for guarding and inspecting levees. The duties and powers of these inspectors include making periodic reports of the condition of levee works and enlisting the aid of district residents to protect levees during emergencies. Penalties for violation of these provisions are provided. (Casey-Florida)
W70-05444

BASE-FLOW-RECESSION CURVES,
For primary bibliographic entry see Field 02E.
W70-05507

FLOOD PLAIN INFORMATION, JORDAN RIVER COMPLEX, SALT LAKE CITY, UTAH.
Corps of Engineers, Sacramento, Calif.

Report prepared for Utah Div of Water Resources and Salt Lake City and County. Corps Engineers Flood Plain Report, October 1969. 21 fig, 28 plate, 6 tab.

Descriptors: *Floods, *Flood damage, *Utah, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Salt Lake City (Utah), Jordan River (Utah), Standard project flood, Intermediate regional flood.

Flooding of the Jordan River, Salt Lake City, Utah is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05518

FLOOD PLAIN INFORMATION, POESTA CREEK AND SALT CREEK, BEEVILLE, TEXAS.
Corps of Engineers, Galveston, Tex.

Corps Engineers Flood Plain Report, April 1969. 35 p, 7 fig, 16 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Beeville (Tex), Standard project flood, Intermediate regional flood.

Flooding of Beeville, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-05519

EXPERIMENTS FOR THE VERIFICATION OF THE PASSAGE THEORY,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02E.
W70-05532

4B. Groundwater Management

REASONABLE STATE REGULATION OF THE INTERSTATE TRANSFER OF PERCOLATING WATER,
Cornell Univ., Ithaca, N.Y. School of Law.
For primary bibliographic entry see Field 06E.
W70-05334

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE,
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 259-306, Oct 1968. 48 p, 4 fig.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Water allocation (Policy), Legislation, Federal government, Prior appropriation, Beneficial use, Federal project policy, Preferences (Water rights), Withdrawal, Water utilization, Groundwater basins, Surface-groundwater relationships, Water sources, Irrigation, Water storage, Supplemental irrigation, Water contracts, Groundwater recharge, Water policy, Competing uses, Project purposes, Federal-state water rights conflicts, Groundwater movement.
Identifiers: *Project groundwater.

Projects under the Federal Reclamation Act have created groundwater in the form of underground basins or return flow into other basins or watercourses. Since legal rights to project groundwater were not determined in the Act, the law has been in a state of flux over allocating those rights. A number of bases for the exercise of rights to project groundwater by the federal government or by the project itself are outlined. Most of these are based on the beneficial use concepts of the prior appropriation doctrine. Specific problems are outlined that are prevalent with relation to use of project groundwater for lands covered by the Act within the project area, lands within the project area but not covered by the Act, and land wholly outside the project area. Solutions derived from existing law are suggested for each category. The most comprehensive solution lies in an amendment to the Act. The author details a proposal which purports to cover the major problem areas discussed. (See also W70-05336 thru W70-05340). (Douberley-Florida)
W70-05335

PROJECT GROUNDWATER PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGAL RIGHTS TO GROUNDWATER),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 259-271, Oct 1968. 12 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Prior appropriation, Federal government, Legislation, Reclamation, Federal project policy, Irrigated land, Irrigation effects, Irrigation programs, Land development, Water utilization, Water allocation (Policy), Subsurface waters, Percolating water, Underflow, Groundwater basins, Surface-groundwater relationships, Water sources, Watersheds (Basins), Preferences (Water rights), Federal jurisdiction.
Identifiers: *Project groundwater.

The purpose of the Reclamation Act was to provide irrigation water to 160-acre farms, to promote western family-sized farms, and to fragment the holdings of large ranchers. Many problems still exist with relation to groundwater created by the storage, transportation and irrigation aspects of the project. Project groundwater is that which either percolates to underground water basins or constitutes return flow to a surface watercourse or groundwater basin further down the watershed. Definite legal authority allocating rights of control or use of project groundwater is lacking, both in the Act and in state statutes. There are existing bases for the exercise of rights by the federal government or by the reclamation project: states may recognize groundwater as water belonging to the project; the Act preserves a project's right to water it subjects to a beneficial use; contracts with water users reserve rights in the federal government; and the United States Supreme Court has upheld the federal government's rights to use groundwater seepage. The Act adopts the law of prior appropriation and beneficial use to govern rights of use in project water. The problem is to balance the furtherance of reclamation against maximation of beneficial use of the resource. (See W70-05335). (Douberley-Florida)
W70-05336

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-EXCESS LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 271-280, Oct 1968. 11 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water contracts, *Beneficial use, Water requirements, Supplemental irrigation, Irrigation water, Surface water, Subsurface irrigation, Prior appropriation, Appropriation, Water rights, Water storage, Usable storage, Withdrawal, Water utilization, Cost-benefit theory, Cost repayment, Project planning, Water utilization, Water allocation (Policy), Irrigation permits, Groundwater recharge.
Identifiers: *Project groundwater, Irrigation subsidies.

The landowner who does not own land in excess of 160 acreas already receives irrigation water at a price below project costs. This subsidy is increased if he is allowed free use of project groundwater to substitute for surface water. The landowner might have a right to the water as a successor to the project's appropriative rights acquired by it from the state. On the other hand, it might be that he receives only the right to water, rather than an unlimited right of use in the water. The soundest analysis is that the landowner's water right is a contractural right, which reserves rights of use in project groundwater in the government or the project. Under the contractural provisions, the landowner should be precluded from withdrawing groundwater presently subjected to beneficial use by the project. The concept of beneficial use could be expanded to include water storage when it is a necessary part of a large scheme of beneficial use or when the development of a groundwater supply will contribute to the project. Alternative solutions include short-term contracts with landowners authorizing withdrawal of water for an appropriate price. (See W70-05335). (Douberley-Florida)
W70-05337

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE EXCESS LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 280-290, Oct 1968. 10 p.

Descriptors: *Water contracts, *Groundwater, *Federal reclamation law, *Water rights, Prior appropriation, Supplemental irrigation, Subsurface irrigation, Irrigation permits, Water permits, Withdrawal, Beneficial use, Irrigation water, Water allocation (Policy), Infiltration, Groundwater recharge, Natural recharge, Artificial recharge, Federal project policy, Project planning, Water policy, Water sources.
Identifiers: *Project groundwater.

The Reclamation Act, by providing an irrigation subsidy for the excess lands if a contract for sale were executed induced the landowner having more than 160 acres to split his holdings. The inducement is subverted if he is able to irrigate the excess lands with project groundwater. The clause in the contract reserving rights in the government to groundwater might be construed as extending to excess lands as well, but this provision should be made clear in future contracts. Withdrawals may also be enjoined if in derogation of the project's appropriative rights, but a beneficial use must be exercised by the project at all times. An expanded concept of beneficial use would be helpful. It should be assumed that all groundwater within the project area is project water, subject to positive proof by a landowner of co-mingling with other groundwater sources. An alternative would be to expand the term water, as used in the Act to include groundwater. Future projects might require contracts relating to water use from all or most of the landowners before the project is instituted. The Act might be amended to allow for supplemental contracts for the use of excess groundwater. (See W70-05335). (Douberley-Florida)
W70-05338

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-PROJECT LANDOWNER PROBLEM),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 290-300, Oct 1968. 10 p.

Descriptors: *Groundwater, *Federal reclamation law, *Water rights, *Withdrawal, Appropriation, Prior appropriation, Consumptive use, Beneficial use, Water contracts, Water utilization, Project benefits, Groundwater basins, Hydrology, Legislation, Underflow, Competing uses, Preferences (Water rights), Groundwater movement, Groundwater barriers, Obstruction to flow, Prescriptive rights, Influent streams, Project purposes.
Identifiers: *Project groundwater, Warren Act.

The landowner who is not a part of the project but who withdraws project groundwater obtains undeserved benefits and causes potential project restriction as a competing appropriator. He is precluded from withdrawing water which is continually subjected to present consumptive benefi-

cial use by the project. Beneficial use may be exercised by expanding the Warren Act or by amending the Reclamation Act to allow contracts for delivery of project water to non-project landowners, pending full utilization of water for irrigation of project lands. As to groundwater basins that extend beyond the project area, it remains within the project's appropriation so long as it is put to beneficial use. Otherwise, a landowner outside the project area might obtain appropriation rights prior to the project. Solutions include drawing project boundaries with reference to underground basins or precluding the establishment of adverse rights through legislation. As to return flow water outside project boundaries, that water may be considered abandoned by the project, but the right to withdraw and use the water for project purposes at a later date is retained. The non-project landowner has only a defeasible interest in such waters. (See W70-05335). (Douberley-Florida)
W70-05339

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGISLATIVE PROPOSALS),
John B. Merritt.
Washington Law Review, Vol 44, No 1, p 301-306, Oct 1968. 6 p, 4 fig.

Descriptors: *Groundwater, *Federal reclamation law, *Preferences (Water rights), Federal project policy, State governments, Federal government, Legislation, Federal-state water rights conflicts, Prior appropriation, Water contracts, Cost-benefit theory, Project purposes, Water utilization, Water permits, Irrigation permits.
Identifiers: *Project groundwater.

A comprehensive solution to project groundwater problems may well come from federal legislation amendatory to the Reclamation Act. The author's proposal provides that state laws shall be inapplicable to the priority and use of water within reclamation projects. Affected state legislatures are to enact a uniform law which recognizes all project groundwater as being exclusively subject to control by the project. Provisions are made for delivery of water to tracts in excess of 160 acres on a short-term contractural basis, with charges varying with the availability of surface and groundwaters. First priority to the use of project waters is to be for delivery and use upon tracts of 160 acres or less, pursuant to the purposes of the original Act. (See W70-05335). (Douberley-Florida)
W70-05340

WELL DRILLERS: REGULATION.

MD Ann Code, Art 96A:80-88 (Supp 1969).

Descriptors: *Maryland, *Well regulation, *Permits, *Water wells, Legislation, Regulation, Administration, Administrative agencies, State governments, Local governments, Rates, Legal aspects, Well permits, Drilling, Core drilling, Drilling equipment.
Identifiers: *Penalties (Civil).

Any person doing business as a well driller in Maryland must comply with this act. Well, well driller, and the business of well drilling are defined. Only licenses as issued under this subtitle shall authorize any person to engage in business as a well driller. Local governments may make and enforce ordinances with respect to the use of water or wells but may not require special authorization to be a well driller. The Maryland State Board of Well Drillers is created to enforce the provisions of this subtitle and to make rules not inconsistent with those herein. The Board shall issue well-driller licenses to qualified applications and shall collect an annual fee for such license privilege. Upon hearing and determination of guilt the Board may suspend or revoke a license for fraud, deceit or gross negligence in license obtainment, or conduct of business. Upon reevaluation such license may be reissued. The Board may enter into reciprocity agreements with other states to allow well drilling without further fee or examination. Penalties for engaging in business as a well driller without a license are provided. (Barnett-Florida)
W70-05351

REUTILIZATION OF WASTEWATER RECYCLED THROUGH GROUNDWATER, VOLUME 1 AND 2.
Eastern Municipal Water District, Hemet, Calif.
For primary bibliographic entry see Field 05D.
W70-05466

EFFECTS OF PUMPING FROM THE OHIO RIVER VALLEY ALLUVIUM BETWEEN CARROLLTON AND GHENT, KENTUCKY,
Geological Survey, Louisville, Ky.
D. V. Whitesides, and Paul D. Ryder.
Kentucky Geological Survey, Series 10, Information Circular 18, 1969. 20 p, 9 fig, 19 ref.

Descriptors: *Induced infiltration, *Aquifers, *Water level fluctuations, *Kentucky, Hydrogeology, Alluvium, Surface-groundwater relationships, Water management (Applied), Withdrawal, Water levels, Water wells, Water yield, Ohio River.
Identifiers: Carrollton (Ky), Ghent (Ky).

Recent industrial expansion coupled with increased groundwater withdrawals has caused water levels in the heavily pumped areas between Carrollton and Ghent, Ky., to decline as much as 30 feet in the past year and a half. Water levels in areas remote from centers of heavy pumping are about normal and fluctuate seasonally. Total amount of groundwater available for withdrawal in the Carrollton-Ghent area is about 10.5 billion gallons. Total pumpage of about 14 million gallons per day from closely spaced industrial wells has resulted in excessive drawdown in localized pumping areas. Induced infiltration from the Ohio River has sustained yields of several million gallons per day in similar areas. Accurate knowledge of induced infiltration characteristics at each heavily pumped area is lacking. This knowledge and proper location of wells near and parallel to the river to maximize river infiltration are critical to the problem of insuring an adequate water supply without excessive drawndown in this area. (Knapp-USGS)
W70-05506

IRRIGATION AND MUNICIPAL WELLS IN THE SAN LUIS VALLEY, COLORADO,
Geological Survey, Denver, Colo.
Philip A. Emery, John M. Dumeyer, and Harold J. McIntyre, Jr.
Geological Survey Open-file Report, November 1969. 7 p, 2 fig, 1 plate, 1 tab, 3 ref.

Descriptors: *Water resources, *Groundwater, *Colorado, *Irrigation water, Water wells, Aquifers, Water supply, Water levels, Water yield, Artesian wells, Water table.
Identifiers: *San Luis Valley (Colo).

The San Luis Valley, Colorado, extend about 100 miles southward from Poncha Pass to a point about 16 miles south of the Colorado-New Mexico State line. The valley has little topographic relief. The altitude of the Colorado part of the valley is about 7,700 feet above sea level. The agricultural economy of the valley depends on irrigation. When the surface-water supply is deficient, groundwater is used as a supplemental supply. The aquifers of the San Luis Valley contain at least 2 billion acre-feet of water. The water occurs in unconfined and confined aquifers. A summary of the thickness, physical character, and water-supply characteristics of the aquifers is given. Records of wells were obtained from the Colorado State Engineer's office, field-checked for accuracy of location, and tabulated. In January 1969, there were 2,883 large-capacity wells in the San Luis Valley. Of this total, 2,228 tap the unconfined aquifer. In addition to the large-capacity wells, there are more than 7,000 small-capacity flowing wells in the valley. (Knapp-USGS)
W70-05508

GEOHYDROLOGY AND GROUNDWATER POTENTIAL OF ST. JOSEPH COUNTY, INDIANA,
Geological Survey, Indianapolis, Ind.
For primary bibliographic entry see Field 02F.
W70-05509

4C. Effects on Water of Man's Non-Water Activities

WILLAMETTE RIVER AT LAMBERT BEND, OREGON- FLOODFLOW CHARACTERISTICS OF THE PROPOSED GREENACRES ROAD CROSSING,
Geological Survey, Portland, Oreg.
For primary bibliographic entry see Field 02E.
W70-05072

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-05118

GROUNDWATER FLOW SYSTEMS AND RELATED HIGHWAY PAVEMENT FAILURE IN COLD MOUNTAIN VALLEYS,
Idaho Univ., Moscow.
Roy E. Williams.
Journal of Hydrology, Vol 6, No 2, p 183-193, April 1968. 11 p, 4 fig, 9 ref.

Descriptors: *Road construction, *Paving, *Drainage systems, *Cold regions, *Groundwater movement, *Ice, Discharge (Water), Percolation, Capillary fringe, Drainage engineering, Pore pressure, Saturation.
Identifiers: *Ice lenses, Groundwater sink, Gravity flow.

Seepage from groundwater systems in cold-region valleys is responsible for the formation and growth of ice lenses beneath highways. Mountains form recharge areas and valley floors become places of discharge and near-surface lateral flow. Ideal conditions for growth of ice lenses are found in frost-susceptible soil, a water source, and the absence of high negative pore-water pressures. Ice lenses grow unusually thick in groundwater discharge areas where the consistent source of water is under positive head. In such areas, highways with impermeable clay or asphalt shoulders may be undesirable. Here roadbeds need draintile networks and/or permeable fill material which would eliminate excess pore-water pressure, lower the capillary fringe, and insure unsaturated conditions, thus limiting growth of ice lenses. Alternatives would include highway location along the valley flank away from discharge areas. (Lang-USGS)
W70-05184

HYDRAULIC PROPERTIES OF STREETS.
Los Angeles Dept. of Public Works, Calif.
For primary bibliographic entry see Field 08B.
W70-05257

NOVAK V TOWN OF AGENDA (LIABILITY FOR WATER DAMAGE WHEN HIGHWAY IS IMPROVED).

172 NW2d 38-42 (Wis 1969).

Descriptors: *Wisconsin, *Road construction, *Surface runoff, *Flood damage, Judicial deci-

sions, Highways, Roadbanks, Road design, Roads, Culverts, Landfills, Overland flow, Storm runoff, Surface waters, Surface drainage, Water injury, Natural flow, Runoff, Condemnation, Damages, Drainage, Drainage patterns, Drainage water, Excess water (Soils), Riddance (Legal aspects).
Identifiers: Inverse condemnation.

Defendant municipality, in resurfacing a highway, raised by landfill a portion of the road adjoining plaintiff's farm and installed a culvert to allow water to flow underneath the road. Plaintiff alleged that the fill and culvert increased the flow of surface funoff onto her land, requiring the digging of a drainage ditch and subjecting her barnyard to possible flooding. Plaintiff instituted an inverse condemnation action for damages. Inverse condemnation allows compensation for a landowner whose land has been taken by a body with the power of condemnation but which failed to exercise it. After hearing disputed testimony, the trial court found that the fill area was far enough from the culvert that the quantity of water channeled onto plaintiff's land was not affected. It further found that the culvert did not change the flow lines of the natural drainage in the area, since excess water had been running over the highway prior to the installation of the culvert. Since plaintiff's land was not wrongfully occupied by the municipality, the action was dismissed. The appellate court affirmed. (Douberley-Florida)
W70-05365

TECHNICAL SERVICES FOR URBAN FLOOD-PLAIN PROPERTY MANAGERS: PROBLEM FORMULATION AND STUDY OF PROPERTY MANAGER RECEPTIVITY,
Northwestern Univ., Evanston, Ill.
Kenneth J. Cypra.
A doctoral dissertation for a Ph. D. in civil engineering, Evanston, Illinois, 1970, p 153, 19 fig, 21 tab, 35 ref.

Descriptors: *Flood plains, *Floodproofing, *Maps, *Methodology, *Non-structural alternatives, Urbanization, Formulation.
Identifiers: *Flood plain management, *Flood plain managers, *Property managers, *Homeowners, *Structural alternatives, *Technical services, *Flood history, *Receptivity, Conclusions, Recommendations.

The author discusses technical services for urban flood plain managers in terms of problem formulation and property manager receptivity. In Chapter I, the problems associated with technical services design are discussed. In Chapter II, property manager receptivity is analyzed in terms of problem scope, definition and formulation. The experimental design is outlined in Chapter III, and Chapter IV deals with the analysis and study results. Conclusions and recommendations are given in Chapter V. The report is significant because it deals with the individual homeowner's willingness to purchase technical flood plain management services designed for his specific needs (non-structural alternatives) rather than services oriented toward a community or regional scale (structural alternatives), e.g., channel improvements, structural abatement. (Richmond-Chicago)
W70-05443

BASIC DATA FOR URBAN HYDROLOGY STUDY, DALLAS, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05500

4D. Watershed Protection

LAND-USE REGULATIONS.

Va Code Ann secs 21-66 thru 21-79 (1960).

Descriptors: *Virginia, *Land use, *Soil conservation, *Natural resources, Legislation, Legal aspects, Regulation, Boundaries (Property), Construction, Outlets, Dams, Dikes, Ponds, Ditches, Structures, Check structures, Reforestation, Drainage, Terracing, Agricultural engineering.
Identifiers: *Forestation, Referendums.

Soil conservation district supervisors are authorized to formulate regulations governing the use of lands within their district. The purpose of such regulations will be the conservation of soil resources and the prevention and control of soil erosion. This section deals with the manner in which proposed regulations are transformed into ordinances by way of referendums. Provision is made for referendums, hearings on proposed regulations, who may vote, the percentage of votes required for approval, and amendment or repeal of regulations. Supervisors may propose regulations which include: (1) provisions requiring engineering operations including the construction of terraces, terrace outlets, check dams, dikes, ponds, ditches and other necessary structures; (2) provisions requiring particular methods of cultivation including the planting of lands to water-conserving and erosion-preventing plants, grasses and trees; forestation and reforestation; (3) specifications of cropping programs and tillage practices; (4) provisions prohibiting cultivation in given areas if this is the only way to control erosion; and (5) provisions for such other means, measures, operations and programs as may assist conservation of soil resources and prevent or control soil erosion. (Keith-Florida)
W70-05445

THE DEVELOPMENT OF DISCONTINUOUS GULLIES IN A PUMICE CATCHMENT,
Sydney Univ. (Australia). Dept. of Geography.
R. J. Blong.
American Journal of Science, Vol 268, No 4, p 369-383, April 1970. 15 p, 2 fig, 4 plate, 6 ref.

Descriptors: *Gully erosion, *Pumice, *Geomorphology, Soil erosion, Climatology, Channel erosion, Infiltration, Groundwater movement, Surface-groundwater relationships.
Identifiers: *New Zealand.

Observations of recent changes in the morphology of pumice gullies on the humid temperate Volcanic Plateau, North Island, New Zealand, provide the basis for a generalized model of sequential gully development. Once gullying ceases, the sidewalls retreat under the influence of blockfall and talus formation to angles of 25 to 35 degrees. Gully wall exposures reveal that similar events have occurred several times since the deposition of Taupo Pumice in 130 A.D. While the influence of land development on modern gully growth may sometimes be important, the effects of climatic events must not be overlooked. The major features of the present gullies and of those formed prior to European intervention are similar. (Knapp-USGS)
W70-05471

COMPILATION OF HYDROLOGIC DATA, MUKEWATER CREEK, COLORADO RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05501

COMPILATION OF HYDROLOGIC DATA, PIN OAK CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05502

COMPILATION OF HYDROLOGIC DATA, NORTH CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05503

COMPILATION OF HYDROLOGIC DATA, GREEN CREEK, BRAZOS RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05504

COMPILATION OF HYDROLOGIC DATA, HONEY CREEK, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-05505

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
For primary bibliographic entry see Field 05C.
W70-05057

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-05058

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
For primary bibliographic entry see Field 05C.
W70-05059

OBJECTIVE ANALYSIS OF THE STRONTIUM-90 CONCENTRATION FIELD IN THE ATLANTIC OCEAN,
Akademiya Nauk URSR, Kiev. Morskyi Hidrofizychnyi Instytut.
V. I. Belyayev, I. F. Doronin, A. I. Yermolenko, T. M. Ivanova, and B. A. Nelepo.
Transl from Izvestiya Akad Nauk SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 8, 1969, pp 860-867. Atmospheric and Oceanic Physics, Academy of Sciences, USSR, Vol 5, No 8, p 489-493, August 1969. 5 p, 4 fig, 2 tab, 10 ref.

Descriptors: *Radioisotopes, *Strontium radioisotopes, *Sea water, *Atlantic Ocean, Mapping, Trace elements, Fallout, Radiochemical analysis.
Identifiers: USSR.

Using the method of objective analysis, a map of the strontium-90 concentration at the surface of the Atlantic Ocean is plotted on the basis of observation data obtained by the research vessel 'Mikhail Lomonosov' for the period 1962-1964. (Knapp-USGS)
W70-05069

A VOLUMETRIC RESPIROMETER FOR STUDIES OF AERIAL AND AQUATIC OXYGEN CONSUMPTION,
Royal Univ. of Malta, Valletta. Marine Biology Research Group.
For primary bibliographic entry see Field 07B.
W70-05089

STUDY OF A WATER-VAPOR ELECTROLYSIS UNIT,
Battelle Memorial Inst., Columbus, Ohio.
J. E. Clifford, B. C. Kim, and E. S. Kolic.
Report avail from Clearinghouse, as NASA CR-1531 - Price $3.00. National Aeronautics and Space Administration Contractor Report NASA CR-1531, March 1970. 38 p, 5 fig, 11 tab, 16 ref, 2 append. NASA Contract NAS 2-2156.

Descriptors: *Electrolysis, *Water reuse, *Oxygen, Ozone, Microorganisms, Systems analysis, Filtration, Activated carbon, Trace elements.
Identifiers: Oxygen production, Sulfuric acid.

Development of acid-type water-vapor electrolysis for oxygen generation in advanced life support systems involved detailed analysis of product gas purity. A sulfuric acid type water-vapor electrolysis module (1/4-man capacity) completed 100 days of satisfactory operation at design conditions. During an additional 45 days of evaluation the small generation rate of ozone and acid spray was controlled to well below the acceptable limits for continuous exposure by use of the usual charcoal and particulate filters used for trace-contaminant control. No other trace contaminants of concern were found in the oxygen (air) or hydrogen at a level of detection of 0.01 ppm. There was preliminary evidence that airborne bacteria were rapidly destroyed. Data on current/voltage relationships for individual cells of the module were obtained. (Knapp-USGS)
W70-05134

A REDUCED-SCALE METHOD FOR THE DETERMINATION OF THE DICHROMATE VALUE (CHEMICAL OXYGEN DEMAND) OF SEWAGE AND TRADE EFFLUENTS,
Nottingham Sewage Disposal Dept. (England).
R. J. Fearn, and W. H. Hetherington.
Journal Society Dyers Colurists, Vol. 83, p146-151, 1967. 9 tab, 8 ref.

Descriptors: *Analytical techniques, *Chemical oxygen demand, Chemical analysis.
Identifiers: *Textile mill wastes, *Dichromate value.

A description is given of a convenient and reliable analytical method for the determination of the dichromate value of sewage and trade effluents including those from textile mills. The method is more rapid than existing macro-scale procedures and is sufficiently analytically accurate and reproducible for the calculation of trade-waste treatment charges. Oxidation with potassium dichromate is carried out in boiling 50% (vol./vol.) sulfuric acid, with a total reagent volume of 30 ml. (Work-North Carolina State Univ)
W70-05148

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07A.
W70-05170

RAPID POLAROGRAPHIC DETERMINATION OF CHLORINE, BROMINE AND IODINE IN ALGAE,
Trieste Univ. (Italy). Inst. of the Science of Properties and Qualities of Commercial Products.
C. Calzolari, L. Gabrielli, and G. Pertoldi Marletta.
Analyst, Vol 94, No 1122, p 774-779, September 1969. 6 p, 1 fig, 4 tab, 15 ref.

Descriptors: *Algae, *Chemical analysis, *Chlorine, *Analytical techniques, *Polarographic analysis, Photometry, Halogens.
Identifiers: Bromine, Iodine.

A rapid method is described for the polarographic determination of chlorine, bromine and iodine in algae after a single combustion procedure. For the determination of chlorine and iodine, the anodic waves of their ions were recorded. For bromine, on the other hand, the bromide ions were oxidized quantitatively to bromate ions, and the cathodic wave for these ions was recorded. The method has been tested on several species of algae from the Gulf of Trieste. (Knapp-USGS)
W70-05178

ON THE BIOLOGICAL SIGNIFICANCE OF PHOSPHATE ANALYSIS; COMPARISON OF STANDARD AND NEW METHODS WITH A BIOASSAY,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 05C.
W70-05269

APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,
E. Geldreich.
Journal of the American Water Works Association, Vol 62, No 2, p 113-120, Feb 1970. 8 p, 53 ref.

Descriptors: *Recreation, *Bioindicators, *Water quality, *Bacteria, Aquatic bacteria, Aquatic microbiology, Aquatic microorganisms, Coliforms, Salmonella, Streptococcus, Water pollution, Water pollution sources, Pollutant identification, Path of pollutants, Animal wastes (Wildlife), Public health, Standards, Farm wastes, Water zoning, Sediment-water interfaces, Domestic wastes, Legal aspects, Sewage bacteria, Pathogenic bacteria.
Identifiers: *Fecal pollution.

Fecal contamination from all warm-blooded animals is the natural link to pathogenic microorganisms in polluted water. The fecal coliform test accurately detects and measures such fecal contamination. Use of the fecal coliform test as a measure of recreational water quality is recommended. Data and tables are given to show a correlation between fecal coliform and the probable occurance of Salmonella, an easily detecting pathogen. Court hearings are cited that establish the legal status of the fecal coliform test. The water-sediment interface of a stream or lake bottom can serve as a reservoir for fecal pollution 'fallout' from overlying water. The fecal-streptococcus group's diverse survival rates and specific fecal origins make them specific indicators for nonhuman, warm-blooded, animal pollution. Various minimal bacterial densities are suggested to insure good recreational water quality. (Cuevas-Florida)
W70-05332

A NEW MIDWATER TRAWL FOR SAMPLING DISCRETE DEPTH HORIZONS,
National Inst. of Oceanography, Wormley (England).
For primary bibliographic entry see Field 07B.
W70-05376

AIRBORNE FLUOROMETER APPLICABLE TO MARINE AND ESTUARINE STUDIES,
Geological Survey, Washington, D.C.; and Perkin-Elmer Corp., Norwalk, Conn.
For primary bibliographic entry see Field 07B.
W70-05377

ENUMERATION OF FRESHWATER PHYTOPLANKTON CONCENTRATED ON THE MEMBRANE FILTER,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-05388

CHEMILUMINESCENT METHOD FOR DETECTING MICROORGANISMS IN WATER,
St. John's Univ., Jamaica, N.Y. Dept. of Biology.
Walter S. Oleniacz, Michael A. Pisano, Martin H. Rosenfeld, and Robert L. Elgart.
Environmental Science and Technology, Vol 2, No 11, p 1030-1033, 1968. 6 fig, 1 tab, 17 ref.

Descriptors: *Analytical techniques, *Microorganisms, *Water, Light, Radiation, Pseudomonas, Salmonella, Bacteria, Water pollution, Light intensity, Bioassay, Pollutant identification.
Identifiers: *Chemiluminescent method, Aerobacter aerogenes, Escherichia coli, Proteus mirabilis, Pseudomonas fluorescens, Salmonella typhimurium, Serratia marcescens, Bacillus subtilis, Alkaline luminol, Sodium perborate, Sodium pyrophosphate peroxide, Staphylococcus aureus.

The need for prompt information regarding presence of microorganisms in water instigated adaptation of a system designed initially for detection of biological aerosols. The analytical technique reported may be useful for monitoring water samples or other aqueous solutions in situations where a rapid indication whether microorganisms are present is required. It may have value as an adjunct or alternative to the plating techniques presently used in the examination of water for microbial content. Two automated systems were devised for the detection of microorganisms contained in water samples. The detection principle was based upon the measurement of light emission resulting from the interaction of microbial cells with alkaline luminol (5-amino-2,3-dihydro-1,4-phthalazinedione) in the presence of sodium perborate or sodium pyrophosphate peroxide. Each automated system detected 1000 to 100,000 viable bacterial cells/milliliter of water seeded with Aerobacter aerogenes, Escherichia coli, Proteus mirabilis, Pseudomonas fluorescens, Salmonella typhimurium, or Serratia marcescens. Maximum light emission occurred within one minute of the admixture of bacterial cells with the luminol reagent. The automated systems displayed linearity in response to varying cell numbers of each test organism. (Jones-Wisconsin)
W70-05391

A SMALL LABORATORY APPARATUS FOR MEASURING ACCELERATED LOSS RATES OF PESTICIDE DEPOSITS BY 'RAINWASHING',
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 07B.
W70-05400

CHLORINATED BIPHENYLS IN FISH, MUSSELS AND BIRDS FROM THE RIVER RHINE AND THE NETHERLANDS COASTAL AREA,
Utrecht Rijksuniversiteit (Netherlands). Inst. of Veterinary Pharmacology and Biological Toxicology.
J. H. Koeman, M. C. Ten Noever De Brauw, and R. H. De Vos.
Nature, Vol. 221, No. 5186, p. 1126-1128; 1969. 2 tab, 2 fig, 13 ref.

Descriptors: *Gas chromatography, *Analytical techniques, Spectrophotometry, DDT, Monitoring, Persistence, Birds, Toxicity, Mussels, Fish.
Identifiers: *Poly chlorinated biphenyls, *Mass spectrometry, Rhine River, DDD, DDE, Residues.

Polychlorinated biphenyls are widely used in industry, and they are now making an appearance in the world's wildlife. Besides being a hazard in their own right, they interfere with the gas chromatographic detection of organochlorine insecticides such as DDT. The occurrence and distribution of PCBs in the Rhine River, and the Netherlands coastal area is described. Identification by mass spectrometry and gas chromatography is elaborated on. The authors suggest continued monitoring of the area to prevent fatal concentrations from occurring. (Sjolseth-Washington)
W70-05425

EVALUATING RISKS OF PESTICIDES TO FISH,
Water Pollution Research Lab., Stevenage (England).
John S. Alabaster.
Proceeding 5th British Insecticide and Fungicide Conference, 1969, p 370-377, 12 ref, 3 fig.

Descriptors: *Pesticides, Bioassay, *Test procedures, *Laboratory tests, *Evaluation, Fish behavior, Toxicity, *Fish, Pesticide toxicity, Analytical techniques, Fish food organisms, Risks, Methodology.
Identifiers: Pesticide uptake, *Long term effects, Residue accumulation.

General requirements for measuring the toxicity of pesticides to fish are outlined, together with the standard test developed by the British Ministry of Agriculture, Fisheries and Food. Tests are discussed in relation to their usefulness for screening purposes and for predicting the effect of pesticides on fisheries under field conditions. Experiments on the uptake of organo-chlorine pesticides by fish are described. (Sjolseth and Katz-Washington)
W70-05431

BIOLOGICAL PRODUCTION AND DISTRIBUTION OF CARBON DIOXIDE IN WOODS HOLE WATERS,
Woods Hole Oceanographic Institution, Mass.
John M. Teal.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 336-340, 1967. 5 p, 3 fig, 2 tab, 4 ref. NSF Grant No GB539.

Descriptors: *Biomass, *Carbon dioxide, Productivity, Photosynthesis, Respiration.
Identifiers: *Woods Hole, Gulf of Maine, Buzzards Bay.

The balance between photosynthesis and respiration taking place in water can be monitored by following changes in carbon dioxide. The distribution of carbon dioxide was measured for the Gulf of Maine, Eel Pond, Woods Hole, and in the water of a salt marsh on Buzzards Bay. In the Gulf of Maine, phytoplankton patchiness was apparent from the patchiness of carbon dioxide distribution. Net carbon production and photosynthesis values were calculated for Woods Hole waters from carbon dioxide content and chlorophyll-a measurements. Net production was positive from December or late November through March. There was a rapid change to negative values in early spring and high negative net production throughout the summer. (Carstea-USGS)
W70-05540

5B. Sources of Pollution

SELF-PURIFICATION OF THE SURFACE WATERS POLLUTED BY WASTE WATER OF THE FOOD INDUSTRY (UNDER CO-INFLUENCE OF BANK PLANTS). (IN GERMAN),
K. Skalski.
Verh. Internat. Verein. Limnol., Vol XIV, p 1054-1056, July, 1961. 4 p, 2 fig.

Descriptors: *Self-purification, *Biochemical oxygen demand, *Dissolved oxygen, *Temperature, Water quality, Saturation, Industrial wastes, Streams, Rivers, Willow tree.
Identifiers: Waste water effects.

Analyses of water quality of the stream Dabrovka (Poland), polluted by a fruit processing factory, is presented. The water quality changes were investigated in a reach of the stream 1.6 km. long below the effluent outfall. In the middle part of this reach a great occurrence of willow growths (Salix viminalis and Salix americana) exists on both sides of the river. The water quality parameters investigated were BOD sub 5 and oxygen saturation, expressed in %. According to these parameters, very quick self-purification occurred - 93.9% removal of BOD sub 5 at a temperature of 17.2 deg C in August, 89.0% removal of BOD sub 5 at an average temperature of 13.0 deg C in September, and 90.7% removal of BOD sub 5 at a temperature of 7.7 deg C in October. The DO dropped to zero in the first part of the reach and recovered in the following sections. This occurred in all cases investigated. The correlation between the self-purification rate and the density of willow growth was observed and explained from the standpoint that the roots of willow form a good environment for organisms effecting self-purification. (Novotny-Vanderbilt)
W70-05047

TEMPERATURE VARIATIONS IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and California Univ., Los Angeles. School of Engineering and Applied Science.
For primary bibliographic entry see Field 02H.
W70-05053

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
For primary bibliographic entry see Field 05C.
W70-05057

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
For primary bibliographic entry see Field 05C.
W70-05059

OBJECTIVE ANALYSIS OF THE STRONTIUM-90 CONCENTRATION FIELD IN THE ATLANTIC OCEAN,
Akademiya Nauk URSR, Kiev. Morskyi Hidrofizychnyi Instytut.
For primary bibliographic entry see Field 05A.
W70-05069

A SOLUTION OF THE COTTON SIZING WASTES PROBLEM,
Hercules Powder Co., Wilmington, Del.
B. W. Dickerson.
Industrial Wastes, Vol. 1, p10-18, 1955. 7 tab, 6 fig.

Descriptors: *Cotton, Biochemical Oxygen Demand, Trickling filters.
Identifiers: *Starch, *Carboxymethyl cellulose, *Warp sizing, Desizing, Textile mill wastes, Dyehouse wastes.

The BOD loads from cotton dyeing and finishing plants vary from 3000 to 30,000 lb/day and waste flows range from 2 mgd to 15 mgd. The major source of BOD is the corn starch used as a warp sizing. The waste water from desizing, may be treated either by chemical precipitation or by biological oxidation using a combination of percolating filters and activated sludge. Experiments were made to determine to what degree BOD can be reduced by using mixtures of starch and carboxymethyl cellulose (CMC). It was found that CMC had a five-day BOD value of 11, whilst the five-day BOD of starch was 812. The CMC does not require an enzyme for desizing and needs only 1/2 of the usual amount of wash water. Pilot-plant studies were made using percolating filters one unit being fed a mixture of sewage, one a mixture of CMC in sewage, and one a mixture of starch in sewage. It has been found that the use of a mixture with 65% starch and 35% CMC in place of starch alone, although being costly in the first instance, gives an appreciable decrease in cost of waste water treatment. The cotton fabric produced by this method is equal to or better than the previous product. Where over-all reductions of BOD value of 30-40% are required, the use of the starch-CMC mixture may result in the elimination of any treatment plant. (Work-North Carolina State Univ)
W70-05075

EUTROPHICATION AND DETERGENTS,
Southam Business Publications Ltd., Don Mills (Ontario). Reader Service Dept; and Toronto Univ. (Ontario).
P. H. Jones, and Tom Davey.
Water and Pollution Control, Vol 106, No 9, p 22-25, 46, September 1968.

Descriptors: *Eutrophication, Phosphorus, *Detergents, Domestic wastes, Pollutants, Water pollution sources, Water quality, Algae, Sewage effluents.
Identifiers: Polyphosphates, Nutrient balance, Foaming detergents, Public apprehension.

Detergents are attacked as a major nutrient source in eutrophication. Soluble polyphosphates serving as filler in detergents help upset nutrient balances in lakes and stimulate algal growth. Other significant sources of biologically active phosphorus are animal and human waste. Because most detergents contain 50% polyphosphates, sewage effluent phosphate has doubled or tripled. Substitute fillers for polyphosphates, which can act as chelating agents and control pH, are now available. Replacing phosphorus in detergents would have an instantaneous beneficial effect at a cost of an extra 15-20 cents a box. Public pressure could force the desired change. Excess phosphorus accelerates a lake's natural aging process. (Bannerman-Wisconsin)
W70-05084

PHOSPHORUS AND WATER POLLUTION,
Agricultural Research Service, Beltsville, Md. Soils Lab.
Alan W. Taylor.
Journal of Soil and Water Conservation, p 228-231, November-December 1967. 4 tab, 26 ref.

Descriptors: *Phosphorus, *Groundwater, *Water pollution sources, Sewage effluents, Eutrophication, Irrigation, Water pollution control, Water chemistry.
Identifiers: Manure, Feedlots, Phosphorus sources, Agricultural fertilizers.

Phosphorus, an important nutrient in natural water, will stimulate excess growth at 0.05 ppm. It is quickly converted to insoluble form in soil and strong sorbtion by soil particles almost completely immobilize it. Pollution from groundwater phosphorus is therefore minimal even though irrigation drainage may cause phosphorus concentration of .08 ppm in groundwater. Eroding topsoils can contribute phosphorus to natural water. Unlike spasmodic erosion flow, manure in stockyards and manure piles supply a steady flow of relatively high phosphorus concentration in available form. Phosphorus pollution from feedlots is significant because concentration of output. Measuring total phosphorus concentration in a water body does not indicate phosphorus available for growth, which is a small fraction of the total. Continuous monitoring of total and available phosphorus concentrations are necessary to assess nutrient sources. One pound of phosphorus dissolved in one acre-foot of water yields a concentration of 0.03 ppm. Phosphorus contamination from sewage effluent is significant, based on a per capita consumption of 2.5 lbs of phosphorus. (Bannerman-Wisconsin)
W70-05098

NITRATES IN THE ENVIRONMENT,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02K.
W70-05099

EFFECT OF STARCH SUBSTITUTES ON TEXTILE WASTES,
J. A. McCarthy.
Sanitalk, Vol. 4, No. 1, p23-25, 1955.

Descriptors: *Waste treatment, Biochemical Oxygen Demand, Cost analysis.
Identifiers: *Carboxymethyl cellulose, *Textile mill wastes, *Starch, Starch substitutes, *Percolating

filters, Textile wastes, Critical Micelle Concentration, Pollutional load discharge.

The extensive use of starch in the processing of textiles, the processes involved, and the high BOD of textile waste waters resulting from its use are outlined. Investigations made at the Lawrence Experiment Station, Massachusetts, on the BOD of starch solutions and solutions of starch substitutes made up to 0.1% solutions, as used in textile mills, showed that whereas the BOD of starch solutions averaged from 600 to 1000 ppm, figures for substitutes were considerably lower, and that in mixtures of starch and CMC exertion of the BOD was retarded. The efficiency of treatment of starch and CMC mixtures on percolating filters was also studied. It was concluded that a reduction in the BOD of textile waste waters could be effected by the use of starch substitutes, giving a reduction in the pollutional load discharge to streams and a reduction in the cost of textile waste treatment. (Mattox, Livengood-North Carolina State Univ)
W70-05156

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-05176

THERMOPHILIC BLUE-GREEN ALGAE AND THE THERMAL ENVIRONMENT,
Oregon Univ., Eugene. Dept. of Biology.
Richard W. Castenholz.
Bacteriological Reviews, Vol 33, No 4, p 476-504, 1969. 4 fig, 4 tab, 187 ref.

Descriptors: *Cyanophyta, *Algae, *Thermal springs, *Oregon, Thermophilic bacteria, Thermao pollution, Nutrients, Temperature, Photosynthesis, Light intensity.
Identifiers: *Yellowstone Park, *Iceland, Mastigocladus laminosus, Phormidium laminosum, Oscillatoria tenuis, Oscillatoria terebriformis, Mats, Synechococcus lividus, Blue-green algae, Filaments.

The blue-green algae in general have higher temperature optima than other algae and some of them, the thermophiles, and inhabitants of hot springs at temperatures as high as 73-74C. It is no surprise, therefore, that thermal pollution may favor the growth of the blue-green algae. Waters from hot springs generally possess much greater solute (nutrient) concentrations than surface waters and it is probable that many thermal streams cause eutrophication in the bodies of water into which they drain. The paper covers the following topics: distribution of thermal waters; distribution of species (upper and lower temperature limits, classification and geographical distribution, problems of survival and transport); studies of natural populations (mat formation and stability, movements of filaments and mats, measurements of photosynthesis and growth); cultivation of thermophilic cyanophytes (mediums and nutrition, isolation and maintenance, rates of growth, rates of photosynthesis, and respiration rates in culture); responses to temperature and light intensity (optimal temperature and light intensity, effects of light and temperature on pigmentation, growth and survival at suboptimal temperatures). (Gerhold-Wisconsin)
W70-05270

HOUSEHOLD WASTE WATER,
National Swedish Inst. for Building Research, Stockholm.
Eskil Olsson, Lars Karlgren, and Victor Tullander.
Available from the Clearinghouse as PB-184 598, $3 in paper copy, 65 cents in microfiche. Report, Byggforskningen-24:1968. 161 p, 98 tab, 36 fig, 58 ref.

Descriptors: *Biochemical oxygen demand, Chemical contamination, Degradation (Decomposition), Phosphorus, Oxygen, Domestic wastes, *Domestic water, Water pollution sources, Municipal wastes.
Identifiers: Sweden, *Grey water, *Household wastewater.

The purpose of this investigation, has been to obtain information about the quantity and nature of waste water from dwelling houses. The results provide a basis for estimating the loading capacity of recipients and the necessary sewage treatment procedures as well as the scaling of drainage networks and treatment plants. However, the principal interest was devoted to a careful analysis of grey water, since information about such water is imperfect. Biochemical oxygen demand, BOD5, was determined every day. A number of BOD curves have been compiled in order to make it possible to assess the rate of reaction and the various steps of decomposition. From the results it is evident that special attention must be paid to the grey water, since it is the grey water that supplies such a large proportion of primary (=direct)pollution.
W70-05304

REVIEW ON TOXIGENIC ALGAE,
Hebrew Univ., Jerusalem (Israel).
Moshe Shilo.
Verhandlungen der Internationalen Vereinigung fur Theorestische und Angewandte Limnologie, Vol 15, p 782-795, 1964. 90 ref, discussion.

Descriptors: *Toxicity, *Algae, *Reviews, Habitats, Clams, Mussels, Shellfish, Dinoflagellates, Cyanophyta, Chrysophyta, California, United States, Brackish water, Estuaries, Bacteria, Mollusks, Vitamin B, Red tide, Salinity, Florida, Texas, Phosphorus, Migration, Diurnal, Algicides, Clostridium, Fish, Amphibians, Anabaena, Cytological studies, Physicochemical properties.
Identifiers: Gonyaulax, Gonyaulax venificum, Pyrodinium, Gymnodinium breve, Canada, Europe, South Africa, Israel, Microcystis, Prymnesium parvum, Synergistic effects, Axenic cultures, Monoalgal, Portugal, Tapes, Japan, Amphidinium, Blooms, Mytilus, Trichodesmium erythreum, Saxidomus, Clostridium botulinus, Venerupis, Ostrea, Arthropods.

Toxigenic algae are found in marine, brackish and fresh water worldwide. High concentrations of toxin-forming organisms, stored in clams, mussels, and shellfish cause food poisoning. Different taxonomic groups contain toxin-forming algae--some Dinoflagellates, certain blue-green algae, and one species of Chrysophyceae. Relationship between algal appearance and toxic phenomena did not prove unequivocally that toxin-formation is caused by algae themselves. Many forms in toxic tides and blooms are now available in axenic culture. Mass development of toxic algae being sporadic, investigators seek for critical combination of physicochemical factors triggering them. Blooms have been associated with upwelling of deep, cool, nutrient-rich water, heavy rainfall with river discharge, sewage pollution, phosphorus concentrations, growth-promoting substances formed by microorganisms, salinity, active or passive concentrations of the cells after growth. Properties and behavior of algal toxins are described. Lack of correlation between concentration of potentially toxic algae and level of toxins in water is emphasized. Intra-and extra-cellular concentrations of toxic principles in axenic Prymnesium cultures varied with stages of growth. Optimal growth conditions were not necessarily optimal for toxin biosynthesis. Shifting concentrations of co-factors, such as streptomycin, spermine, and others as yet unknown may alter toxic effect without changes in toxin level. (Jones-Wisconsin)
W70-05372

MAN, WATER, AND ENVIRONMENT,
Water Pollution Research and Applications, Inc., Washington, D.C.
Jacob I. Bregman.
Archives for Environmental Health, Vol 20, p 100-104, January 1970.

Descriptors: *Water quality control, *Standards, *Laws, Federal jurisdiction, Legislation, Project planning, Water policy.
Identifiers: Drinking water standards, Public Health Service, Congress, Water quality standards, Federal clean-water aids.

Some contributing factors in US water pollution have been population growth, urbanization and suburbanization, industrial expansion, higher incomes and expectations, and untested use of new technology. 1965-66 saw two major water pollution bills passed by Congress. The national cleanup program is administered by the Department of the Interior, which is in charge of developing water quality standards, providing aid for comprehensive planning, research, and waste treatment plants, and providing legal enforcement when incentives fail. The states have the task of deciding goals, determining what levels of pollution are consistent with the goals, and setting schedules. Some Department of Interior policies are that there should be no degradation of existing water quality, no waters shall be used solely or principally as a waste carrier, all wastes given 'best' practicable treatment prior to discharge, consistency of standards among adjoining and downstream states, standards must anticipate population and industrial growth, no exceptions to particular industries or areas, and standards should be feasible and achievable. (Powers-Wisconsin)
W70-05384

GAS CHROMATOGRAPHIC CHARACTERISTICS OF CHLORDANE. I. EFFECT OF AN AQUEOUS ENVIRONMENT ON THE HEPTACHLOR COMPONENT,
Hawaii Univ., Honolulu. Dept. of Agricultural Biochemistry; and Hawaii Univ., Honolulu. Dept. of Food Science and Technology.
Arthur Bevenue, and Chee Yee Yeo.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 2, p 68-76, 1969. 1 fig, 15 ref.

Descriptors: *Pesticides, *Pesticide toxicity, *Heptachlor, Chemicals, Gas chromatography, Crops, Soil contamination effects, Water pollution effects, Bioassay, Chlorinated hydrocarbon pesticides.
Identifiers: *Chlordane, Biocides, Diels-Alder adduct.

A marked decrease in the heptachlor component of chlordane was recorded during the first 24 hours exposure of the biocide to water. After 14 days, the content of heptachlor decreased to nearly zero from 1 ppm solution. Water exposed for 14 days to chlordane vapors was enriched in heptachlor. The claim that heptachlor in water is rapidly converted to heptochlor epoxide is the disagreement with the findings obtained with distilled water. The gamma and alpha fractions of the biocide might be used to quantitate residues of chlordane in crops, soil, and water. The changes in commercial chlordane, revealed in this study, most likely would influence chromatographic results obtained by analyses of blood, urine, and tissue samples in cases related to ill effects produced by exposure to chlordane. (Wilde-Wisconsin)
W70-05403

CHAPTER XII: RECEIVING-WATER MONITORING: KEY TO SEATTLE METRO'S POLLUTION-ABATEMENT PROGRAM,
Seattle Metropolitan Municipality, Wash.
Charles V. Gibbs.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, Seattle, University of Washington Press, 1968, p. 179-186, 1 fig.

Descriptors: *Monitoring, *Pollution abatement, *Data processing, Planning, Conservation, Fisheries, Industrial wastes, Fresh water, Saline water, Ecology, Costs, Benefits.

Identifiers: *Metro, *Green-Duwamish River program, *Puget Sound, U.S. Geological Suryey, *Lake Washington Ship Canal, State regulatory agencies, Review requirements, Pollution Control Commission, Water Quality Control Division, Effluent disposal, Pacific Ocean.

The pollution abatement and prevention program undertaken by the municipality of Metropolitan Seattle (Metro) in 1959 is outlined. Working under the philosophy that a discharger has the responsibilities for monitoring its receiving waters, Metro has established a Water Quality Control Division and has assigned it the task of planning and implementing the necessary programs. Cost for the entire program ($135 million by 1972) and costs and benefits for specific aspects of it are indicated. Water-quality monitoring was recognized at the outset to be of critical importance because of conservationists' opposition regarding effluent disposal when the plan was presented to state regulatory agencies in 1960. The monitoring and review requirements established by the Pollution Control Commission are outlined along with a set of six objectives of the Metro program. Three divisions of the program--a Water Quality Section, an Ecological Section, and an Industrial Waste Section--are pointed out and the distinct problems at each of the four separate monitoring programs indicated. The Green-Duwamish River program involves a freshwater stream and its terminal estuary. Puget Sound is an arm of the Pacific Ocean. Lake Washington-Lake Sammamish drainage basin requires work on the large lakes and many small tributary streams. Lake Washington Ship Canal system necessitates work on several small lakes connected by deep water canals influenced by intrusion of salt-water. Cooperative studies with the U.S. Geological Survey are mentioned and details of the electronic data-processing system presented. (See W70-03995). (Preckwinkle-Chicago)
W70-05452

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
Donald J. Benson.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, University of Washington Press, 1968, p. 187-195.

Descriptors: *Water quality control, *Water pollution control, *Beneficial use, *Downstream, *Pollutants, *Water Quality Act, *Sites, *Waste disposal, *Zoning, *Standards, Legal aspects.
Identifiers: *Puget Sound, *Washington State, *Continuous assessments, Pollution Control Act, Pollution Control Commission, Public Law 660, FWPCA, Water quality criteria.

Review of legal and technical issues related to pulp-mill waste-water discharges into Puget Sound suggests that philosophical as well as technical questions appear to be at the heart of the problem. The term 'water-pollution control' needs to be replaced by 'water-quality control.' A basic concept of water-quality control is the theory of downstream beneficial use. This means that the residents upstream will control discharges so that beneficial uses downstream are not impaired. Categories of beneficial use are listed in addition to types of contaminants that can reduce water quality below beneficial use levels. A two-pronged approach to enforcement of the beneficial use theory is presented including continuous assessment of water quality and beneficial uses with waste-discharge requirements dependent upon these stream determinants. 'Known and reasonable' methods of control are suggested and the salesmanship approach is averred to be more successful than legal proceedings. Complications with the theory of downstream beneficial use are illustrated by instances in which a second mill is located on a stream where satisfactory requirements were being met by a first mill. Technical means of reducing polluted flow are mentioned and zoning proposed for land and water based on forecasts of future basin water requirements in supporting particular potential kinds of industry. Public hearings required by the Federal Water Quality Act of 1965 are held to recognize proper water quality criteria principles and the highly technical engineering matters involved. (See W70-03995). (Preckwinkle-Chicago)
W70-05453

THE MOVEMENT OF BACTERIA AND VIRUSES THROUGH POROUS MEDIA,
Colorado Div. of Water Resources, Denver. Ground Water Section.
John C. Romero.
Ground Water, Vol 8, No 2, p 37-48, March-April 1970. 12 p, 3 fig, 4 tab, 26 ref, append.

Descriptors: *Path of pollutants, *Bacteria, *Viruses, *Porous media, *Groundwater movement, Seepage, Water pollution sources, Filtration, Reviews, Surveys, Sanitary engineering, Waste disposal.
Identifiers: Well sanitation.

This report is the result of a request by the State Board of Examiners of Water Well and Pump Installation Contractors. The Board is in the process of formulating a more reasonable set of guidelines which control the location of wells designed to produce water for human consumption and/or food processing with respect to potential or existing sources of ground-water pollution. The pollution of groundwater supplies appears belatedly and often is not recognized until a relatively large area has been contaminated. Soils and aquifer materials have capacity to remove or 'filter' some types of contaminants. The results of several pertinent groundwater pollution investigations are briefly described and current and potential standards for governing 'safe distances' between domestic-food processing wells and sources of potential or existing pollution are given. The recommendations are meant to emphasize the fact that no one set of distances are adequate and reasonable for all conditions. Whenever possible the safe-distance between a subject well and a source of potential or existing pollution should be based on local conditions. It is important that we develop knowledge that will permit continued use of the soil mantle as a waste-water treatment system and at the same time permit continued use of ground water for human consumption and/or food processing. Functional legal, administrative and engineering mechanisms must be developed to maintain this combined usage. (Knapp-USGS)
W70-05477

THE ESTUARY--SEPTIC TANK OF THE MAGALOPOLIS,
Public Health Service, Metuchen, N.J. Div. of Water Supply and Pollution Control.
Paul De Falco, Jr.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 701-703, 1967. 3 p.

Descriptors: *Estuaries, *Water pollution sources, *Water pollution control, Pollutants, Chemical oxygen demand, Storm runoff, Pesticides, Fertilizers, Industrial wastes, Municipal wastes, Analytical techniques, Membranes, Filters, Septic tanks.
Identifiers: Raritan Bay project, Estuarine pollution.

The sources of pollution in estuaries such as stormwater overflow and drainage from suburban areas with fertilizers and pesticides are discussed. Many oyster and clam beds, fisheries, and recreational areas along the main estuaries of the United States have disappeared or cannot be used due to water pollution. Sanitary engineers, microbiologists and biologists are faced with serious problems in their fight to hold the ground against pollution. The complex combination of municipal and industrial wastes with salt water is difficult to characterize. New methodology was developed in the Raritan Bay project. Among the new methods listed are a modified chemical oxygen demand test; a modified mitrate-nitrite test; use of membrane filter; method for separation of pollution-tolerant organisms in marine waters. (Carstea-USGS)
W70-05537

TECHNICAL APPROACHES TOWARD EVALUATING ESTUARINE POLLUTION PROBLEMS,
Public Health Service, Portland, Oreg. Div of Water Supply and Pollution Control; and Washington State Dept. of Fisheries, Brinnon. Shellfish Lab.
For primary bibliographic entry see Field 05C.
W70-05538

THE ROLE OF MAN IN ESTUARINE PROCESSES,
Maryland Univ., Solomons. Natural Resources Inst.
L. Eugene Cronin.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 667-689, 1967. 23 p, 5 fig, 125 ref.

Descriptors: *Estuaries, *Water pollution, *Water management (Applied), Water quality, Research and development, Silting, Dams, Barriers, Spillways, Engineering structures, Levees, Diversion, Thermal pollution, Salinity, Nutrients, Radioactive wastes, Pulp wastes.
Identifiers: Bonnet Carre Spillway, Potomac River, Delaware diversion.

Human activity upstream which modifies estuaries includes modification of river flow, organic enrichment, dams and barriers, spillways, and diversions. In estuaries, man's modifications include: physical processes such as landfill, thermal pollution, salinity change, and modifications of basins; and chemical processes such as use of biocides, nutrient enrichment, and radioactive wastes. Among the biological processes, human predation (fishing) and artificial introduction of species are reviewed. Basic research in this complex and challenging estuarine environment is critically needed. Intelligent management, research, and public education are vital to the optimal future use of estuaries. (Carstea-USGS)
W70-05539

5C. Effects of Pollution

FORMATION AND MAINTENANCE OF THERMOCLINES IN STRATIFIED LAKES INCLUDING THE EFFECTS OF POWER PLANT THERMAL DISCHARGES,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
T. R. Sundaram, and R. G. Rehm.
AIAA Paper No. 70-238, AIAA 8th Aerospace Sciences Meeting, New York, January 19-21, 1970. 14 p, 9 fig, 36 ref.

Descriptors: *Thermal pollution, *Temperature, *Stratification, Thermocline, Turbulence, Winds, Thermal power plants, Diffusivity, Mathematical model.
Identifiers: Richardson number, Friction velocity.

Temperate lakes generally exhibit a vertical thermal structure which is characterized by a nearly homothermal upper layer with a sharply defined lower boundary (the thermocline). Under the assumption of horizontal homogeneity (deep lake), the equation describing the vertical transport of heat is (partial differential of T)/ (part. diff. t) = ((part. diff.)/ (part. diff. Z)) ((K sub H) ((part. diff. T)/ (part. diff. Z))) where T is the temperature, t is the time, Z is the distance measured downward from the surface and K sub H is eddy diffusivity for the vertical transport of heat. The influence on the eddy diffusivities of the interaction between the turbulence structure and the buoyancy gradients was included. The nonlinear equations of the problem were then solved using an electronic

computer. It is shown that, while the vertical temperature profile at the start of warming season is fairly smooth, the thermocline is soon formed by nonlinear interaction between wind induced turbulence and stable buoyancy gradients due to surface heating. It is also demonstrated that continuous downward erosion of the thermocline into the deeper layers of the lake is a necessary part of its sustenance. It is observed that, if the effect of thermal discharges is to cause either an increase in temperature or in heat flux, then the time of formation of the thermocline, as well as its depth, are reduced. (Upadhyaya-Vanderbilt)
W70-05050

INFLUENCE OF TEMPERATURE REGIME ON THE SELF-PURIFICATION PHENOMENON OF STREAMS. (IN RUMANIAN),
Hydrological Research Inst., Bucharest (Rumania).
J. Pietraru.
Russian, English, French, and German summaries.
Hydrotechnica, Gospodarirea Apelor, Meteorologia, Vol. 12, No. 4, April 1967, p. 194-199, 5 fig., 3 ref.

Descriptors: *Temperature, *Self-purification, Water quality, Water pollution, Water utilization, Water policy, Water resources, Water pollution treatment, Reaeration, Waste assimilative capacity, Path of pollutants, Heated water.

Temperature regime influence on self-purification of the river Arges is described. Temperature data were summarized to get the overall picture about the seasonal changes of the stream temperature and the evaluation of data was used for establishing the necessary treatment degrees in the river basin. For this computation, the thermal factor Theta defined by Streeter and Phelps was used both for deoxygenation computation (Theta = 1.047) and for reaeration (Theta = 1.0159). After those theoretical considerations, the parameters for that computation which are proposed to be used in Rumania are presented and discussed. (Novotny-Vanderbilt)
W70-05054

INFLUENCE OF THERMAL POWER PLANTS ON STREAMS. (IN FRENCH),
Electricite de France. Service de la Production Thermique.
A. Goubet.
Delegation Generale au District de la Region de Paris, December, 1965, 115 p.

Descriptors: *Thermal pollution, *Temperature, *Thermal power plants, *Cooling water, *Streams, Thermal properties, Thermal stratification, Dissolved oxygen, Water pollution, Self-purification, Chemical properties, Biological properties, Bacteria, Mixing, Weather data, Thermodynamic behavior, Equilibrium, Heated water.

This report deals with determination and analysis of the influence of four steam electric power stations on streams below the stations. The report is divided into 7 parts. First it contains the statistical temperature analysis of each of the four streams. The mixing of waters with different temperatures is discussed in the second part. The author's conclusion is that from the standpoint of influence on aquatic life, the average cross-sectional temperature should be the main parameter. The effect of cooling in the channel and streams is solved in the third part. The author used the formula Theta = Theta sub o exp (Lx/QD) where the thermal exchange coefficient D is the recommended value of D = 75. In this equation Theta sub o is an initial temperature difference between the actual water temperature and the temperature which would occur if no heat pollution existed; Q is the discharge of water in the stream, (m cu.)/sec; x is the distance downstream in km; L is the width of the river in m, and D is a constant dependent on meteorological conditions. The following parts deal with the influence of power stations on chemical and biological properties. The change of oxygen content of water passing through the cooling cycle is negligible. The influence on other chemical substances and similarly on biological and bacteriological properties has not been proved. (Novotny-Vanderbilt)
W70-05055

PERSISTENT PESTICIDES IN THE ENVIRONMENT,
Rothamsted Experimental Station, Harpenden (England); and Minnesota Univ., St. Paul. Inst. of Agriculture.
Clive A. Edwards, and Russell S. Adams.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 7-67, February 1970. 61 p, 3 fig, 22 tab, 297 ref.

Descriptors: *Pesticide residues, *Hazards, *Pollutants, *Reviews, Bibliographies, Fishkill, Pesticide kinetics, Distribution patterns, Path of pollutants, Pesticide toxicity, Pesticide removal, Public health, Water pollution sources, Pesticide drift, Water quality, Environment, Ecology.
Identifiers: Persistent pesticides.

The results are summarized of some of the more important pesticide residue surveys and experimental studies of residues in both the physical and biological sections of the environment, in order to assess the present state of knowledge of the status of pesticide residues in the environment. Recent data are presented on the amounts of residues in all compartments of the environment to show how they are concentrated from the physical to the biological parts of the environment and into the upper trophic levels of food chains. The most difficult thing to assess from data currently available is not what the present situation is, but what changes will occur if certain actions, for example a ban on a particular pesticide, are taken. The cycling of pesticides in the environment is summarized to illustrate the movements of residues through the various compartments of the environment. A bibliography of 297 entries is included. (Knapp-USGS)
W70-05057

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Engineering; and California Univ., Davis. Dept. of Agricultural Engineering.
Raymond C. Loehr, and Samuel A. Hart.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 69-99, February 1970. 31 p, 7 fig, 9 tab, 67 ref.

Descriptors: *Reviews, *Bibliographies, *Water pollution sources, *Farm wastes, Waste treatment, Aesthetics, Odors, Sewage disposal, Disposal, Farm management, Water pollution control, Environment, Water quality, Air pollution, Urbanization.
Identifiers: Animal production wastes.

This review emphasizes one facet of agriculture, animal production as an example of the changes that have taken place in agriculture. The major topic areas include: productivity increases, changes in size of operations, handling problems, waste characteristics, surface and groundwater quality, land application of wastes, land runoff, odor production, and waste management techniques. Because farms are located in relative isolation surrounded by apparently unlimited land, air, and water, contaminants generated by agriculture usually would be sufficiently dilute or stabilized before potential problems become real. Modern developments in agriculture and growing recreational use of rural lands are tending to eliminate this relative isolation. The large livestock producer is in the animal rather than in the crop-farming business. He relies on commercially available feeds for a considerable portion if not all of his feeding requirements, has a minimum interest in utilization of the resultant manure in crop production, and may not have adequate land of his own for satisfactory disposal of the animal wastes. The outlook is for continuation of these trends in modern agriculture and for an increase in the environmental problems described in this review. No new facility or expansion of existing facilities for agricultural production should be considered without prior planning which should include the probable environmental effects of the disposal of wastes from the facility. (Knapp-USGS)
W70-05058

PHYSICAL AND ENGINEERING ASPECTS OF THERMAL POLLUTION,
Vanderbilt Univ., Nashville, Tenn.; and New York State Dept. of Health, Albany.
Frank L. Parker, Peter A. Krenkel, and Donald B. Stevens.
CRC Critical Reviews in Environmental Control, Vol 1, No 1, p 101-192, February 1970. 92 p, 13 fig, 14 tab, 423 ref.

Descriptors: *Water pollution effects, *Thermal pollution, *Reviews, *Bibliographies, Environment, Aquatic environment, Water temperature, Aquatic habitats, Regulation, Standards, Water Quality Act, Water quality, Costs, Water pollution control.
Identifiers: Thermal pollution effects.

The rate of growth of cooling water requirements with particular reference to central electricity generating stations, the possibilities of improved efficiencies in electricity production, the limited availability of cooling water and the mechanisms and means of heat dissipation are detailed. Also described are the effects of heated discharges upon the biota and the hydrodynamics of the receiving waters. It has been shown that new plant sizes will be such that only in a few areas of the country will we be able to meet biologically derived standards if run of the river cooling is used. It has also been shown that expectations of increased flow or reduced cooling requirements due to increased thermal efficiencies are not likely to be realized. We cannot expect to find sufficient beneficial uses of the degraded heat to substantially diminish the problem. The choice will be whether to pay the price for preventing the excess heating of our surface waters or to accept the consequences of discharging these heated effluents and let them take their toll. A bibliography of 423 entries is included. (Knapp-USGS)
W70-05059

GEOCHEMICAL ENVIRONMENTS AND CARDIOVASCULAR MORTALITY RATES IN GEORGIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02K.
W70-05067

THE INFLUENCE OF NITROGEN ON HETEROCYST PRODUCTION IN BLUE-GREEN ALGAE,
Bureau of Commercial Fisheries, Ann Arbor, Mich. Biological Lab.
Roann E. Ogawa, and John F. Carr.
Limnology and Oceanography, Vol 14, No 3, p 342-351, 1969. 7 fig, 4 tab, 26 ref.

Descriptors: *Algae, *Cyanophyta, *Nitrogen fixation, Nutrients, Lake Erie.
Identifiers: *Heterocysts, Anabaena variabilis, Microcystis aeruginosa, Aphanizomenon flos-aquae, Oscillatoria, Anabaena cylindrica B629, Anabaena inaequalis 381, Anabaena flos aquae, Tolypothrix distorta, Gloeotrichia echinulata LB 1303.

Indirect evidence is presented suggesting involvement of heterocysts in utilization of atmospheric nitrogen as sole nitrogen source for algae. Seven heterocystous (known atmospheric nitrogen-fixing) blue-green algae were grown in a modified Chu No 10 medium devoid of combined nitrogen; two non-heterocystous (non-atmospheric-fixing) blue-greens did not grow in this medium. Hetero-

cysts were produced shortly after inocula devoid of heterocysts were placed in nitorgen-free medium. Production was greatest when atmospheric nitorgen served as sole nitrogen source, and least when ammonia-nitrogen served as sole nitrogen-source. Nitrate-nitrogen produced an intermediate number of heterocysts. When medium nitrate-nitrogen content was varied as sole nitrogen source, numbers of heterocysts produced were inversely proportional to the nitrogen concentration. They did not develop in the absence of phosphorus, but no effort was made to determine the critical phosphorus concentration for their production. Production of heterocysts in circumstances of low combined nitrogen may provide an ecological advantage. The relative numbers of heterocysts in field-collected samples indicate the relative amount of available nitrogen and a continuing supply of available phosphorus. (Gerhold-Wisconsin)
W70-05091

MEASUREMENT AND DETECTION OF EUTROPHICATION,
Central Coastal Regional Water Quality Control Board, San Luis Obispo, Calif.
For primary bibliographic entry see Field 02L.
W70-05094

EUTROPHICATION OF A TIDAL ESTUARY,
Cornell Univ., Ithaca, N.Y. Dept. of Conservation.
For primary bibliographic entry see Field 02L.
W70-05102

FACTORS AFFECTING GROWTH OF ROOTED AQUATICS IN A RIVER,
Tennessee Valley Authority, Muscle Shoals, Ala. Environmental Biology Branch; and Washington Univ., Seattle. Dept. of Civil Engineering.
W. H. Peltier, and E. B. Welch.
Weed Science, Vol 17, No 4, p 412-416, 1969. 1 fig, 2 tab, 5 ref.

Descriptors: *Rooted aquatic plants, *Rivers, *Plant growth, Tennessee, Walls, Nutrients, Sediments, Depth, Turbidity, Light penetration, Decomposing organic matter, Dissolved oxygen, Industrial wastes, Ammonia, Temperature, Phosphorus, Nitrogen, Biomass, Sands, Sago pondweed, Nitrates, Phosphates, Productivity, Distribution, Plant tissues, Growth rates, Velocity, Light quality, Rainfall, Solar radiation, Flood control, Dams.
Identifiers: Holston River (Tenn), Skimmer, Tennessee Valley Authority, Elodea, Potamogeton pectinatus, Potamogeton crispus, Heteranthera dubia Jacq, Vallisneria americana Michx, Nutrient loads, Critical levels, Area, Substrate.

Plant masses dislodge and float downstream, clogging the water intake skimmer wall at the Tennessee Valley Authority's steam plant. These aquatic plants also contribute significant amounts of decomposing organic matter causing serious reduction of dissolved oxygen; low dissolved oxygen levels in a downstream reservoir may be partially due to this transported organic matter. During 1967 field studies on the Holston River, Tennessee, and in the laboratory, evidenced that excessive aquatic plant growths are not solely related to the presence of large amounts of nutrients. Factors contributing to growth were the amount of nutrients in sediments, water depth, and turbidity. Water depth and turbidity influence the amount of light which penetrates the water and is available for rooted plant growth. The aquatic plant studied was sago pondweed (Potamogeton pectinatus L), the dominant plant in the upper Holston River. Experimental work is needed to separate the relative importance of light, sediment composition, and temperature on the growth of these nuisance aquatic plants if ecological control methods are to be determined. Unavailability of data comparing annual plant growth in relation to hydrographic and climatic conditions compounds the problem. (Jones-Wisconsin)
W70-05105

REPORT UPON THE CAUSE OF OFFENSIVE ODORS FROM LAKE MONONA, MADISON, WISCONSIN,
Alvord, Burdick and Howson, Chicago, Ill.
For primary bibliographic entry see Field 02H.
W70-05107

GLUCOSE AND ACETATE IN FRESHWATER: CONCENTRATIONS AND TURNOVER RATES,
North Carolina State Univ., Raleigh. Dept. of Zoology.
John E. Hobbie.
Proceedings of International Biological Program symposium held in Amsterdam and Nieuwersluis, October 10-16, 1966. Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, 1967. p 245-251, 5 fig, 9 ref.

Descriptors: *Chemical analysis, Organic matter, Water pollution effects, Analytical techniques, Kinetics, Aquatic bacteria, Algae, Physiological ecology, Carbon radioisotopes, Lakes, Phytoplankton, Bioassays.
Identifiers: *Glucose, *Acetate, *Freshwater environments, *Turnover rates, *Heterotrophy, Organic solutes, Sweden, Lake Erken (Sweden), Annual cycles, Microbial ecology, Radiocarbon uptake techniques, Michaelis-Menten equation, Relative heterotrophic potential, Lineweaver-Burk equation, Uptake velocity, Maximum uptake velocity, Substrate concentrations.

Organic solutes in the hydrosphere are extremely diverse, and their dynamic properties have greater ecological significance than do their instantaneous concentrations. Useful information regarding heterotrophic potential of lacustrine bacteria can be derived from analysis, according to enzyme-type kinetics originally proposed by Michaelis and Menten, of their uptake of radiocarbon-labeled substrates. Such treatment yields estimates of uptake velocity; maximum uptake velocity (V); turnover time (T); and relative measure (K + S) of concentrations of naturally-occurring substrates concentration (S), where K is analogous to Michaelis-Menten constant. These kinetic parameters, followed over one annual cycle, are described for glucose and acetate in Lake Erken, Sweden. V, varying 40-fold, followed algal cycles closely, peaking in June and September. That constant removal and supply of both compounds are in balance, and that they do not accumulate is indicated by seasonally constant value for (K + S), naturally-occurring concentrations (in micrograms/liter) remaining at approximately 6 for glucose, and 10 for acetate. T varied from 10 hours (summer) to approximately 1000 hours (winter). When T = 10, sizeable fraction of naturally-occurring dissolved organic carbon in lake is cycled, illustrating ecological value of knowing T as compared with knowing S. (See W70-04821 thru W70-04823). (Eichhorn-Wisconsin)
W70-05109

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1942 TO JULY 1943,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05112

INVESTIGATION OF THE ODOR NUISANCE OCCURRING IN THE MADISON LAKES PARTICULARLY LAKES MONONA, WAUBESA AND KEGONSA FROM JULY 1943 TO JULY 1944,
Public Health Service, Madison, Wis.; and Wisconsin Univ., Madison. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02H.
W70-05113

PHOSPHORUS CONCENTRATIONS IN THE PAMLICO RIVER ESTUARY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
John E. Hobbie.
Available from the Clearinghouse as PB-190 441, $3.00 in paper copy, $0.65 in microfiche. Completion Report, North Carolina Water Resources Research Institute, Report No. 33, March 16, 1970. 47 p, 9 tab, 15 fig, 9 ref. OWRR Project B-004-NC.

Descriptors: *Estuaries, *Eutrophication, *Nutrients, *Phosphorus, Phosphates, Water pollution sources.
Identifiers: *Pamlico River, *North Carolina.

The Pamlico River of North Carolina is a naturally rich estuary of shallow depth and six inch lunar tide. The natural levels of phosphorus are 0.031 - 0.062 mg/l. As a result of phosphate mining levels as high as 2.9 mg/l have been measured. This report summarizes data collected bi-weekly since 1967. The conclusions are: (1) The Texas Gulf Sulphur Company is adding large amounts of phosphorus to the waters of the Pamlico River. This phosphorus is entering from the plant site and not from the decant water of the slimes-settling basin. (2) The phosphorus added by the phosphate mining and fertilizer manufacturing operation does not appear to be changing the ecology of the River because more than enough phosphorus for normal algal photosynthesis is already present. (3) Phosphorus concentrations in the Tar River entering the upper estuary have tripled since 1967. This is likely due to sewage and indicates that nitrogen compounds are also increasing (unpublished evidence bears this out). (4) Phosphorus concentrations are already above the 0.04 mg P/l (2.8 ug-at P/l) level that marks the limit between polluted and unpolluted waters. If sufficient nitrogen compounds become available from sewage or farm land drainage, then intense eutrophication and eventually pollution of this estuary will result within the next two decades.
W70-05115

CHEMICAL AND THERMAL CHARACTERISTICS OF KEYSTONE RESERVOIR,
Oklahoma Water Resources Research Inst., Stillwater.
For primary bibliographic entry see Field 02H.
W70-05121

MINE DRAINAGE IN THE NORTH BRANCH POTOMAC RIVER BASIN,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Leo J. Clark.
Chesapeake Technical Support Laboratory Technical Report No 13, Federal Water Pollution Control Admin, Middle Atlantic Reg, August 1969. 87 p, 29 fig, 9 tab, 15 ref, append.

Descriptors: *Acid mine water, *Water pollution effects, *Water pollution treatment, *West Virginia, *Maryland, Costs, Economics, Water quality, Data collections, Hydrologic data, Water chemistry, Acidic water, Aquatic habitats, Mine acids, Coal mine wastes, Strip mine wastes, Waste water (Pollution).
Identifiers: Potomac River.

Water quality and mine drainage pollution of the North Branch Potomac River are surveyed. For over a century, mine drainage has been the primary cause of degradation in the basin. More than 40 miles of the main stem above Luke, Maryland, and over 100 miles of tributary streams are now virtually devoid of aquatic life because of the effects of mine drainage. The principal constituents of mine drainage are total dissolved and suspended solids, acid, iron and manganese, and toxic precipitates. An estimated 79,000 lbs/day of acidity is contributed by streams within the State of West Virginia and 39,000 lbs/day by streams within the State of Maryland. Active coal mines in West Vir-

ginia appear to be a significant, and perhaps the largest, source of acid mine drainage while in Maryland, drainage from inactive mines appears to be the most significant source. A preliminary estimate of annual expenditures required to provide necessary prevention, collection, and treatment measures in the seven most critical watersheds of the Potomac basin is $5,000,000. Capital costs are estimated at $32,500,000. (Knapp-USGS)
W70-05176

THE MODIFICATION OF PLANET EARTH BY MAN,
California Univ., Santa Barbara.
Gordon J. F. MacDonald.
Technol Rev, p 27-35, Oct/Nov 1969. 9 p, 3 fig.

Descriptors: *Environment, *Environmental effects, Air pollution, *Air pollution effects, Atmospheric pollution, Climates, Climatology, Albedo, *Earthquakes, Hazards, Heat balance, Carbon dioxide, Disasters, Oceans, Solar radiation, *Earth (Planet), Injection wells.
Identifiers: *Climatic changes, Atmospheric dust, Earthquake theory.

Man's technology is changing his physical environment in ways that are not clearly understood, endangering man's future on earth. Two major problems discussed are: how man is changing the climate and how he is producing earthquakes. The climate could be altered by carbon dioxide, aerosols, dust, changing the albedo of the earth's surface, and altering the transfer of momentum and heat between the ocean and atmosphere by oil spills. The seismic activity associated with the waste injection well near Denver, Colo., and the impounding water at Hoover, Kariba, and Koyna Dams are discussed. The large-scale lowering of groundwater table and underground nuclear explosions may also have effects on seismic activity. Evidence indicates that great earthquakes consist of a superposition of lower magnitude earthquakes. The man-made disturbances are approaching the critical magnitude range that could start a sequence of events producing a catastrophic earthquake. (USBR)
W70-05249

A LIMNOLOGICAL INVESTIGATION OF WATER QUALITY CONDITIONS IN LAKE SAMMAMISH,
Seattle Metropolitan Municipality, Wash.
Gary W. Issac, Robert I. Matsuda, and John R. Welker.
February 1966. 47 p, 16 fig, 9 tab, 11 ref.

Descriptors: *Lake morphology, *Eutrophication, *Ecology, *Limnology, *Biocontrol, Lakes, Nutrients, Chemical analysis, Sampling, Monitoring, Water quality, Water pollution effects, Pollution abatement.
Identifiers: *Lake Sammamish, *Metropolitan Seattle, *Municipality of Metropolitan Seattle, Seattle, Lake Washington.

This report is a detailed account of a morphological investigation of the water quality of Lake Sammamish, conducted in the 18 month period ending December, 1965. The Lake is situated outside of the present eastern boundary of Metropolitan Seattle (Metro). Its outlet, the Sammamish River, flows generally within Metro's boundary and discharges into Lake Washington. Metro's program of constructing facilities to remove sewage inputs to Lake Washington is nearly completed. Therefore, to permit the tributary lake to continue its pollution of Lake Washington would be contrary to all previous efforts. Twelve physical, chemical and biological monitoring stations were established throughout Lake Sammamish to collect information on temperature, transparency, nutrients, dissolved oxygen, phytoplankton and zooplankton populations, primary productivity and bacteriological analysis necessary for an accurate evaluation of the present lake conditions. It was concluded that Lake Sammamish is in a more advanced state of eutrophication than was Lake Washington in 1950, and that steps should be taken to reduce nutrient contributions and provide sewerage systems to convey the sewage away from the Lake for treatment and disposal. (Poertner-Chicago)
W70-05256

THE EFFECT OF LIGHT ON NITRATE AND NITRITE ASSIMILATION BY CHLORELLA AND ANKISTRODESMUS,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02K.
W70-05261

THE CONTROL OF ESTUARINE POLLUTION,
Forth River Purification Board, Langgarth (Scotland).
For primary bibliographic entry see Field 02L.
W70-05262

SUMMARY OF LITERATURE ON AQUATIC WEED CONTROL,
Toronto Univ. (Ontario).
J. Murray Speirs.
Canadian Fish Culturist, Vol 3, No 4, p 20-32, 1948. 55 ref.

Descriptors: *Aquatic weed control, *Bibliographies, Cattails, Bulrush, Dredging, Copper sulphate, Pondweeds, Sodium arsenite, Fish, Animals, Algae, Cutting management, Potable water, Herbicides, Chara, Alkalinity, Bullheads, Eels, Killifishes, Trout, Suckers, Bass, Water hyacinth, Frogs, Crayfish, Mosquitoes, Bacteria, Irrigation, Willow trees, Fertilizers, Burning.
Identifiers: *Literature, Eleocharis, 2,4-D, Ammate, Chloramine, De-K-Pruf-21, Benoclors, Nigrosine dye, Sodium chlorate, Santobrite, Cladophora, Potamogeton spp, Lake Mendota (Wis), Anacharis, Naias, Scirpus, Nymphaea, Crassipes eichornia, Typha, Brasenia, Dow contact, Sparganium, Salix, Growth regulators, Myriophyllum, Water blooms, Chaining.

Several methods are available to control particular aquatics. To control emergent aquatics such as cattails, bulrushes and spikerushes, 2,4-D or ammate are effective for permanent control; dredging and use of a flame thrower are adequate temporary controls. To control algae, copper sulphate appears to be efficient; chloramine may be equally useful but requires additional testing; for algae coating concrete or wooden walls of fish tanks or reservoirs, De-K-Pruf-21 is suggested. The most effective control for pondweeds appears to be sodium arsenite but caution must be exercised where the water might be a drinking supply for mammals (including man). Benoclors are effective controls where fish and other aquatic animals are unimportant; nigrosine dye may be used to shade out the pondweeds where the black color given the water is acceptable; in some waters, pondweeds have been controlled by adding enough fertilizer to produce a water bloom shading out the pondweeds; this method may have merit where dense algal growths are preferable to pondweed growths. Water lilies are particularly resistant to chemical control methods, and persistent cutting appears the only satisfactory method. (Jones-Wisconsin)
W70-05263

THE ECOLOGY OF A RESERVOIR,
Paul A. Erickson, and John T. Reynolds.
Natural History, p 48-53, November 1969. 4 fig.

Descriptors: *Water quality control, *Ecology, *Reservoir, Massachusetts, Potable water, Water pollution, Bacteria, Algae, Nutrients, Indicators, Odor, Taste, Filters, Water treatment, Dissolved oxygen, Eutrophication, Fish, Land, Value, Leaves, Fertilizers, Pesticides, Cellulose, Cycles, Harvesting, Dredging, Monitoring, Microbiology, Food chains.
Identifiers: Quabbin Reservoir (Mass), Boston (Mass).

Techniques designed to slow the eutrophication process are: reduction of nutrients by controling sewage waste disposal, and chemical fertilizers possibly leaching into the watershed, and by bacterial decomposition of bottom sediments; by mechanical harvesting of algal populations, rooted and blossoming plants; dredging; removal of dissolved nutrients by physical and chemical agents; removal of algal populations by chemical agents and reduction by increasing fish populations. The financial and physical problems associated with their actual application are immense, as a reservoir is the focus of socio-political factors which must be weighed in any procedure. Another possibility for slowing down eutrophication lies in the unique studies, classified as 'microbial intervention.' If the reservoir ecosystem could be managed to favor bacteria groups that already compete with algae for decomposed organic nutrients, the algal food chain would be broken and algal populations of undesirable proportions could not occur, thus maximizing the reservoir's self-cleansing capability. Microbial intervention would tend to soothe the political and social pulse, for it is a 'natural process.' Precise information describing interactions of algal and bacterial populations must be understood before they can be manipulated for human benefits. (Jones-Wisconsin)
W70-05264

HALF-SATURATION CONSTANTS FOR UPTAKE OF NITRATE AND AMMONIUM BY MARINE PHYTOPLANKTON,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
Richard W. Eppley, Jane N. Rogers, and James J. McCarthy.
Limnology and Oceanography, Vol 14, No 6, p 912-920, 1969. 5 fig, 2 tab, 33 ref.

Descriptors: *Phytoplankton, *Marine microorganisms, *Nitrates, *Ammonium compounds, *Absorption, Water pollution effects, Nutrients, Kinetics, Physiological ecology, Growth rates, Dinoflagellates, Diatoms, Environmental effects, Cycling nutrients, Oligotrophy, Eutrophication, Regression analysis, Chemical analysis, Chlorophyta, Chrysophyta, California.
Identifiers: *Half-saturation constants, Rhizosolenia stolterfothii, Coccolithus huxleyi, Leptocylindrus danicus, Gonyaulax polyedra, Rhizosolenia robusta, Ditylum brightwellii, Skeletonema costatum, Chaetoceros gracilis, Cell size, Cyclotella nana, Microbial ecology, Coscinodiscus lineatus, Coscinodiscus wailesii, Asterionella japonica, Biological oceanography, Gymnodinium splendens, Monochrysis lutheri, Isochrysis galbana, Dunaliella tertiolecta, Michaelis-Menten equation, Nutrient limited growth, Irradiance, Temperature effects, Coccolithophores.

Sensitive pre- and post-incubation analyses for nitrate and ammonium permitted determination of uptake rate (v) as a function of ambient concentration (S) of these nutrients for nitrogen-depleted cells of 16 species of laboratory-cultured marine phytoplankters, including diatoms, coccolithophores, dinoflagellates, chrysophytes, and chlorophytes. Graphic plots of v versus S yielded hyperbolic relationships, kinetic analysis of which gives estimates of half-saturation constants (K-sub-s, that concentration supporting half-maximum v) having ecological significance as they reflect relative ability of organisms to utilize nutrients present in low concentrations. K-sub-s, so determined, were generally similar for both nutrients, with oceanic species demonstrating lowest values. Approximately, K-sub-s varies proportionately with cell size and inversely with specific growth rate, varying between 0.1 (Coccolithus huxleyi, an oceanic species) and 10.3 (Gonyaulax polyedra, a neritic dinoflagellate, for nitrate). Confidence limits (95%) are presented for determinations of the constant. For four species--where data exists relating specific growth rate (Mu) to irradiance temperature, and day length-- variation in Mu with ambient nitrate and ammonium concentrations can be calculated, thus permitting useful ecological

predictions regarding interspecific competition in terms of those environmental characteristics. (Eichhorn-Wisconsin)
W70-05265

A NUMERICAL MODEL FOR THE ESTIMATION OF PHOTOSYNTHETIC PRODUCTION, INTEGRATED OVER TIME AND DEPTH, IN NATURAL WATERS,
Wisconsin Univ., Milwaukee. Center for Great Lakes Studies.
Everett J. Fee.
Limnology and Oceanography, Vol 14, No 6, p 906-911, 1969. 2 fig, 9 ref.

Descriptors: *Mathematical models, *Estimating equations, *Numerical analysis, *Photosynthesis, *Primary productivity, *Aquatic environments, Analytical techniques, Water pollution effects, Systems analysis, Digital computers, Light intensity, Lakes, Light penetration, Optical properties, Phytoplankton.
Identifiers: *Temporal variation, *Depth variation, *Integration, Vollenweider's photosynthesis model, Photoinhibition, Photobiology, Trophic biology, Irradiance, Empirical data, Extinction coefficient.

Integration over time and depth of photosynthetic rates (P) is complicated by inhibition of photosynthesis at high light levels. In absence of photoinhibition, P asymptotically approaches upper limiting value (P-max) with increasing irradiance (I). An available model (Vollenweider's) accounts for photoinhibition by relating relative photosynthesis (= ratio, P/P-max) to relative light intensity (= ratio, I/I-sub-k) in equation with two empirical parameters (a, n), where I-sub-k is saturating light intensity, defined by assuming linear approach of P to P-max. Model is illustrated with figures of families of curves for arbitrarily selected values of a and n. Vollenweider achieved exact solution of depth integral by fixing values of a and n, and assuming cosine distribution of daily irradiance, but failed to identify appropriate solutions for particular data sets relating P to I. Method reported here achieves generality, employing two computer programs to estimaters model parameters and solve double integral. Data required are: depth distribution of P; short-term P at optimal I; extinction coefficient of water column; temporal measurements of surface irradiance, usually over course of a day. Solution is considered biologically inadequate in sense that it fails to consider variations in photosynthetic parameters and in phytoplankton distributions with depth and time. (Eichhorn-Wisconsin)
W70-05266

ON THE BIOLOGICAL SIGNIFICANCE OF PHOSPHATE ANALYSIS; COMPARISON OF STANDARD AND NEW METHODS WITH A BIOASSAY,
Minnesota Univ., Minneapolis. Limnological Research Center.
William Chamberlain, and Joseph Shapiro.
Limnology and Oceanography, Vol 14, No 6, p 921-927, 1969. 2 fig, 2 tab, 13 ref.

Descriptors: *Water chemistry, *Water pollution effects, *Phosphates, *Analytical techniques, *Bioassays, Organophosphorus compounds, Solvent extractions, Phosphorus compounds, Lakes, Sewage effluents, Arsenic compounds, Spectrophotometry, Algae, Minnesota, Sodium arsenite.
Identifiers: Arsenate interference, Dissolved inorganic phosphates, Soluble reactive phosphorus, Phosphate (Biologically available), Microcystis aeruginosa, Lake Como (Minn), Lake Vadnais (Minn), Mille Lac (Minn), Deming Lake (Minn), Orchard Lake (Minn), Lake Owasso (Minn), Lake Josephine (Minn), Gray's Bay (Minn), Smith's Bay (Minn), Phosphate determination methods.

The possibility exists that standard analytical methods might overestimate dissolved inorganic phosphate, thus modified techniques have been introduced to operate an operationally defined fraction of phosphorus compound, 'soluble reactive phosphorus.' Availability of various analytical procedures raises the question of which one measures the phosphorus fraction which is important as a plant nutrient. Two sewage effluents and water from 11 Minnesota lakes were analyzed by four procedures: Harvey method, 6-second method, solvent extraction, Stephens method. Analytical results were compared with magnitude of phosphate uptake during a bioassay employing phosphorus-starved cells of blue-green alga, Microcystis aeruginosa. Waters could be arranged into two groups based upon magnitude of difference between results of Harvey method and extraction procedure. Waters of group II, where such differences were large, all were high in arsenate (16-56 micrograms arsenate-arsenic/liter), arsenate interference from such concentrations being sufficiently large to account for discrepancies in phosphate determinations. Extraction procedure is less sensitive to arsenate interference than are other methods. In analyzing lake water for phosphates, it is advisable to assume that arsenic is present. Phosphate analyses resulting from extraction procedure were in good agreement with biologically available phosphates as determined by bioassay. (Eichhorn-Wisconsin)
W70-05269

AMINO ACID FLUX IN AN ESTUARY,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 02L.
W70-05271

DDT REDUCES PHOTOSYNTHESIS BY MARINE PHYTOPLANKTON,
State Univ. of New York, Stony Brook. Dept. of Electrical Engineering.
Charles F. Wurster, Jr.
Science, Vol 159, p 1474-1475, March 1968. 2 fig, 21 ref.

Descriptors: *Water pollution effects, *Photosynthesis, *Phytoplankton, *DDT, *Marine algae, Toxicity, Diatoms, Estuaries, Physiological ecology, Massachusetts, Chlorophyta, Dinoflagellates, Algae, California, Florida, Pesticide residues, Ecosystems, Food chains, Biological communities, Bioassays, Eutrophication.
Identifiers: Skeletonema costatum, Coccolithus huxleyi, Pyramimonas, Peridinium trochoideum, Vineyard Sound (Mass), Woods Hole (Mass). Radiocarbon uptake techniques, Microbial ecology, Coccolithophores, Seawater medium f.

Widely distributed in the hydrosphere, the insecticide DDT has potentially great and diverse ecological effects. Little is known about its influence on phytoplankton. Over range of concentrations 1-500 ppb, its effect on photosynthesis, under controlled conditions of light and temperature, was determined for a natural population of phytoplankton and for four species of laboratory cultured marine phytoplankters: Skeletonema costatum (diatom), Coccolithus huxleyi (coccolithophore), Pyramimonas (green alga), Peridinium trochoideum (dinoflagellate). When photosynthesis (measured as percentage of radiocarbon uptake by untreated controls) is plotted against increasing dosage of DDT, characteristic sigmoid curves result, with photosynthesis decreasing approximately linearly in dosage range 1-100 ppb DDT. Sigmoid dose-response curves apparently indicate absence of threshold levels below which no effects occur. Testing relationship in Skeletonema between cell concentrations and toxicity revealed that photosynthesis diminished to 50% of controls when final cellular concentrations were reduced 100-fold. For chemical reasons, effective doses of DDT in these experiments may be lower than quantities added initially. Moreover, because DDT becomes available naturally at steady rates, given concentration in nature would have greater ecological significance than same initial experimental concentration. Selective toxic stress by DDT may create floral imbalance, thereby aggravating less desirable manifestation of eutrophication. (Eichhorn-Wisconsin)
W70-05272

EFFECTS OF THERMAL STRATIFICATION AND NUTRIENT AVAILABILITY ON THE PRODUCTIVITY OF RESERVOIR PHYTOPLANKTON,
Tennessee Valley Authority, Chattanooga. Biology Section.
Mahlon P. Taylor, and Eugene B. Welch.
Tennessee Valley Authority, Div of Health and Safety, Water Quality Branch, Chattanooga, Mimeo, May 1968. 36 p. 9 fig, 4 tab, 19 ref.

Descriptors: *Productivity, *Phytoplankton, *Fertilization, Nitrogen, Phosphorus, Thermal stratification, Analytical techniques, Epilimnion.
Identifiers: Clinch River (Tenn), Carbon-14 techniques, Fertilizer loss, Norris Reservoir (Tenn), Tennessee Valley Authority, Mono-ammonium phosphate, Ammonium sulfate, Chlorophyll a, Photic zone.

Six coves on Norris Reservoir on the Clinch River, Tennessee, were fertilized at 2-week intervals with mono-ammonium phosphate and ammonium sulfate, mixed in 16-20-0 ratio. The primary phytoplankton production was determined by carbon-14 technique. Other determinations included chlorophyll a, total phosphorus, forms of nitrogen, total inorganic carbon, and photic depth. Under the influence of thermal stratification and reduction of phosphorus content in the epilimnion, productivity declined in May and remained low until September. The fall increase in the epilimnetic phosphorus content induced accelerated productivity. Applied fertilizer sank from the epilimnion in less than 6 hours and the difference between the average productivity of control and fertilized coves was not statistically significant at 95% confidence level. (Wilde-Wisconsin)
W70-05274

POLUTION AND POVERTY: THE STRATEGY OF CROSS-COMMITMENT,
Roger Starr, and James Carlson.
The Public Interest, NO. 10, Winter 1968, p 104-131. 28pp, 6 ref.

Descriptors: *Water pollution, Pollution abatement, Governments, Biochemical oxygen demand.
Identifiers: *Poverty.

The fight against pollution is charged with emotional enthusiasm that may reverse itself when the public discovers that many now polluted waters cannot be fully restored, and that many expenditures of anti-pollution funds will have been to no avail. The question of how to define clean water is raised. The use of biochemical oxygen demand as a measure of organic pollution is examined. The problems developed are: who should have responsibility for what actions, and what local interests and national needs must be reconciled. Three sources of pollution are given: agricultural activity, industrial plants large enough to discharge their effluents directly into waterways, and rainfall. Each source is examined as to the possibilities of preventing pollution. Problems of technology and costs of treating sewage and developing sewers are discussed. The cross-commitment of the public to stopping pollution and stopping poverty (through housing, jobs, education and income supplements) has resulted in competition for funds. (Grossman-Rutgers)
W70-05285

THE EFFECT OF DELETERIOUS CONCENTRATIONS OF COPPER ON THE PHOTOSYNTHESIS OF CHLORELLA PYRENOIDOSA,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02K.

W70-05370

REPORT OF THE COMMITTEE ON TERMS AND EQUIVALENTS,
International Council for the Exploration of the Seas, Charlottenlund (Denmark).
For primary bibliographic entry see Field 07C.
W70-05371

THE RELATIONSHIP OF FRESH-WATER PROTOZOAN COMMUNITIES TO THE MACARTHUR-WILSON EQUILIBRIUM MODEL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; Virginia Polytechnic Inst., Blacksburg. Dept of Forestry and Wildlife; and Michigan Univ., Ann Arbor. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-05374

DISTRIBUTION AND ABUNDANCE OF PHYTOPLANKTON AND ROTIFERS IN A MAIN STEM MISSOURI RIVER RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
For primary bibliographic entry see Field 02H.
W70-05375

THE PHYSICAL-CHEMICAL LIMNOLOGY OF A NEW RESERVOIR (BEAVER) AND A FOURTEEN YEAR OLD RESERVOIR (BULL SHOALS) LOCATED ON THE WHITE RIVER, ARKANSAS AND MISSOURI,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
For primary bibliographic entry see Field 02H.
W70-05380

THE ADAPTATION OF PLANKTON ALGAE. IV. LIGHT ADAPTATION IN DIFFERENT ALGAL SPECIES,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02K.
W70-05381

BIOLOGICAL EFFECTS OF INDUSTRIAL DEFILEMENTS IN THE RIVER BILLEBERGAAN,
Lund Univ. (Sweden). Limnological Inst.
Ingemar Sorensen.
Acta Limnologica (Sweden), 1948. 73 p, 17 fig, 5 tab, 41 ref, appendix.

Descriptors: *Rivers, *Water pollution effects, *Water pollution sources, Industrial wastes, Fishkill, Self-purification, Fish diseases, Chlorine, Fungi, Microorganisms, Fish, Diatoms, Populations, Physicochemical properties, Analysis, Ammonium compounds.
Identifiers: *Billebergaan River (Sweden), Sweden, Potassium cyanide, Laundry wastes, Ammonium hydroxide.

This contribution to the knowledge of water pollution reports fish poisoning and other biological injuries caused by a discharge of cleaning and laundry chemicals. The first fishkill was followed a week later by another mortality caused by an attack of fungi on specimens weakened by chemicals. The microzoan population was largely destroyed and was not regenerated for several weeks. The microphyte population has undergone considerable change in its composition, characterized by a great increase in diatoms. The effect of pollution was expressed in marked increase of the downstream water in potassium, magnesium, oxygen and especially in oxygen demand and biochemical oxygen demand. A supplemental tabular record of some 300 species of microphyta and microzoa inhabiting rivers is included; the organisms are classified into four divisions in accordance with their frequency of occurrence. (Wilde-Wisconsin)
W70-05385

ALGAE AND PHOTOSYNTHESIS IN SHAGAWA LAKE, MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 02H.
W70-05387

MEASUREMENTS OF EUTROPHICATION AND TRENDS,
Wisconsin Univ., Madison. Water Resources Center.
E. Gus Fruh, Kenton M. Stewart, G. Fred Lee, and Gerard A. Rohlich.
Journal of the Water Pollution Control Federation, Vol 38, No 8, p 1237-1258, 1966. 8 fig, 4 tab, 116 ref.

Descriptors: *Measurement, *Eutrophication, *Biomass, *Primary productivity, *Wind pressure, Lakes, Sampling, Biological properties, On-site investigation, Phytoplankton, Zooplankton, Chlorophyll, Transparency, Nutrient requirements, Oxygen, Nitrogen, Phosphorus, Chlorine, Sulfates, Toxicity, Epilimnion, Benthos, Hypolimnion, Analytical techniques, Cores, Stratification, Thermocline, Water pollution treatment, Waste water, Zoning, Water quality, Manpower.
Identifiers: Eutrophication rate, Specific conductance, Carbon-14 analysis, Suspended solids, Desirable trends, Surveillance.

A survey of data pertinent to living and abiotic constituents of lake waters revealed that an appraisal of the state and the rate of water eutrophication demands a diversity of periodic physical, chemical, and biological measurements. Such analyses must embrace a number of sampling sites exposed to different environmental conditions and anthropogenic influences. The sampling should be adequate and frequent enough to provide a statistically significant record of the spacial and temporal dynamics of water basins. The preferred biological analyses include areal or volumetric measurements of algal stands, determination of chlorophyll and primary productivity, regression in depth of rooted aquatics, biomass and nature of zooplankton, occasionally including benthic fauna and fish. Of no lesser importance are analyses of sediment cores, the epilimnion-hypolimnion ratio, the rate of oxygen consumption, biochemical oxidation of reduced compounds, water transparency, and nutrient budgets, not necessarily limited to those of nitrogen and phosphorus. Particular attention must be given to the contributions of nutrients and toxic substances delivered to the basin by natural, agricultural, and urban drainage, as well as by wastewater effluents. (Wilde-Wisconsin)
W70-05394

THE TURNOVER RATIO IN PRODUCTION ECOLOGY OF FRESHWATER INVERTEBRATES,
Minnesota Univ., St Paul. Dept. of Entomology, Fisheries, and Wildlife.
For primary bibliographic entry see Field 07B.
W70-05396

ON THE THEORY OF ADDING NUTRIENTS TO LAKES WITH THE OBJECT OF INCREASING TROUT PRODUCTION,
Dalhousie Univ., Halifax (Nova Scotia). Zoological Lab.
For primary bibliographic entry see Field 02H.
W70-05399

LIMNOLOGICAL RELATIONS OF INDIAN INLAND WATERS WITH SPECIAL REFERENCE TO WATERBLOOMS,
University Coll., London (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05404

THE EUTROPHICATION OF LAKE KLOPEINER (In German),
Biologische Station Lunz (Austria).
For primary bibliographic entry see Field 02H.
W70-05405

ENVIRONMENTAL REQUIREMENTS OF FRESH-WATER PLANKTON ALGAE,
Uppsala Univ. (Sweden). Inst. for Physiological Botany.
For primary bibliographic entry see Field 02H.
W70-05409

NUTRIENT REMOVAL A UNIVERSAL REQUIREMENT,
For primary bibliographic entry see Field 02H.
W70-05412

THE AGING GREAT LAKES,
For primary bibliographic entry see Field 02H.
W70-05415

THE PHYTOPLANKTON OF SOME IRISH LOUGHS AND AN ASSESSMENT OF THEIR TROPHIC STATUS,
Bristol Univ. (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-05416

PHOSPHATE FERTILIZATION OF PONDS,
Alabama Agricultural Experiment Station, Auburn.
For primary bibliographic entry see Field 02H.
W70-05417

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 06A.
W70-05420

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,
Ontario Water Resources Commission, Toronto.
M. G. Johnson, M. F. P. Michalski, and A. E. Christie.
Ontario Water Resources Commission, Division of Research - Publication No 30, 1969. 41 p, 5 tab, 6 fig, 15 ref, 3 append.

Descriptors: *Acid mine water, Acidic water, Hydrogen ion concentration, Water chemistry, *Phytoplankton, Carbon dioxide, Nutrient requirements, Populations, Environmental effects, *Primary productivity, Water pollution effects, Bioassays, Algae, Comparative productivity, Aquatic productivity, Distribution, Species diversity.
Identifiers: Ontario lakes, Quirke Lake, Pecors Lake, Dunlop Lake, *Inorganic carbon.

Studies were carried out on three Northern Ontario lakes; two (Quirke and Pecors Lakes) were contaminated by free mineral acidity and one (Dunlop Lake) was unaffected. Lower phytoplankton populations and indices of diversity were found in Quirke and Pecors Lakes than in Dunlop Lake. Many species of Bacillariophyceae, Chrysophyceae and Myxophyceae developed in the reference lake but were absent or occurred in extremely low numbers in the contaminated lakes. Average primary productivities in Dunlop, Quirke and Pecors Lakes were 126, 71 and 34 mg C m- (2) day- (1), respectively. In situ areal and volumetric measurements in laboratory and field bioassays confirmed the importance of inorganic carbon in limiting primary productivity. It is concluded that inorganic carbon limits primary productivity in the lakes contaminated by acid mine wastes, with the reduced pH and inorganic carbon decreasing both the number of species and total number of phytoplankton. (Sjolseth and Katz-Washington)
W70-05424

CHLORINATED BIPHENYLS IN FISH, MUSSELS AND BIRDS FROM THE RIVER RHINE AND THE NETHERLANDS COASTAL AREA,
Utrecht Rijksuniversiteit (Netherlands). Inst. of Veterinary Pharmacology and Biological Toxicology.
For primary bibliographic entry see Field 05A.
W70-05425

PESTICIDES AND THE WESTERN GREBE - A STUDY OF PESTICIDE SURVIVAL AND TROPHIC CONCENTRATION AT CLEAR LAKE, LAKE COUNTY, CALIFORNIA,
Rochester Univ., N.Y. Dept. of Radiation Biology and Biophysics.
S. G. Herman, R. L. Garrett, and R. L. Rudd.
Chemical Fallout - Current Research on Persistent Pesticides, Chapter II, p 24-53, 1969. 8 tab, 7 fig, 17 ref.

Descriptors: Water birds, *DOT, Trophic level, *Pesticide residues, *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Mortality, Pesticide kinetics, Reproduction, Gas chromatography, Distribution.
Identifiers: *Clear Lake (Calif), *Western Grebe, Aechmophorus occidentalis, *Trophic concentration, DDD, DDE, Reproductive success, Reproductive inhibition.

The Clear Lake, California ecosystem contains chlorinated hydrocarbon residues, chiefly of the DDT series. The effects of trophic concentration are most obvious in the Western grebe, a fish-eating bird, in which both acute mortality and reproductive inhibition, presumably attributable to high residue loads, have combined to cause population declines. This report centers on probably pathways of residue transfer and on the precise manner in which reproduction might be affected. Various aspects of the population biology of the Western grebe and its prey species are described. The breeding population of this colonially nesting species is approximately 150 pairs. Regular aerial censusing shows variation in total numbers throughout the year as well as differential distribution in the lake. Residue loads in grebe tissues have remained relatively high over several years, averaging, as examples, in 1967 in DDD alone 544 ppm (wet weight) in subcutaneous fat, 296 ppm (lipid weight) in eggs, and 546 ppm (lipid weight) in the yolk sacs of hatching grebes. All fishes contain DDD and other residues. Residues in grebes vary seasonally and appear strongly correlated with feeding rates and selection of prey types. (Sjolseth and Katz-Washington)
W70-05426

THE INCREASING CHAOBORID MIDGE PROBLEM IN CALIFORNIA,
S. F. Cook, Jr.
California Vector Views, Vol. 14, No. 6, p 39-44, June 1967. 4 tables, 8 refs.

Descriptors: Limnological, *Aquatic environment, Midges, Impoundments, *Insect control, Larvae, Reservoirs, Aquatic population, Lake morphalogy, Environmental effects.
Identifiers: Clear Lake (Calif), Chaoborid midges, *Chaoborus astictopus, *Insect populations, *Seasonal population variations.

Surveys of many artificial water impoundments in California indicate that the Clear Lake 'gnat', Chaoborus astictopus (Diptera: Chaoboridae), is becoming widespread throughout the state. The abundance of these nuisance midges in many reservoirs and smaller pounds rivals the densities previously associated with Clear Lake, Lake County. Limnological data acquired on many bodies of water sampled indicate little correlation between gnat numbers and lake or pond character. In view of the statewide nuisance potential of these organisms, and the rapidly increasing shoreline development of impounded water, it is recommended that a state supported research program be initiated to study the basic aspects of chaoborid control in California. (Sjolseth and Katz-Washington)
W70-05427

THE POTENTIAL ROLE OF FISHERY MANAGEMENT IN THE REDUCTION OF CHAOBORID MIDGE POPULATIONS AND WATER QUALITY ENHANCEMENT,
For primary bibliographic entry see Field 05G.
W70-05428

SOME EFFECTS OF A NEUTRAL MIXTURE OF CALCIUM OXIDE AND SULFURIC ACID ON CHANNEL CATFISH ICTALURUS PUNCTATUS (RAFINESQUE),
Kansas Univ., Lawrence. Dept. of Zoology.
Richard E. Sparks, John Cairns, Jr., and Frank B. Cross.
Transactions of the Kansas Academy of Science, Vol 72, p 1-15, No 1, 1969. 7 tab, 1 fig, 14 ref.

Descriptors: *Lime, *Channel catfish, Water pollution effects, *Bioassay, Toxicity, Mortality, *Suspended load, Calcium sulfate, Waste disposal, Solid wastes.
Identifiers: *Calcium oxide, *Sulfuric acid, Ictalurus punctatus, Kill Creek (Kans), Ammunition plant, Gill disorders.

An Army Ammunition Plant discharges waste containing sulfuric acid neutralized with slaked lime into Kill Creek, a tributary of the Kansas River. Channel catfish, Ictalurus punctatus (Rafinesque), are indigenous to both streams. Twelve channel catfish, kept in a synthetic waste approximating that of the plant, died within two days when a suspended solids concentration of 24,200-30,400 mg/l was maintained by vigorous aeration. Ten out of 15 channel catfish survived in synthetic waste for the 22-28 day duration of the experiments when a suspended solids concentration of 367-509 mg/l was maintained by moderate aeration. Eleven of 12 catfish survived 22-28 days in synthetic waste from which all settleable solids were removed, and 17 of 22 catfish kept in tapwater as controls survived 22-28 days. The findings of this study suggest that acid treatment plants should remove settleable solids from neutralized waste before it is discharged, thereby preventing at least one potential stress on some fish in receiving streams. (Sjolseth-Washington)
W70-05429

DDT: SUBLETHAL EFFECTS ON BROOK TROUT NERVOUS SYSTEM,
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
J. M. Anderson, and M. R. Peterson.
Science, Volume 164, p 440-441, April 25, 1969. 1 fig, 1 tab, 9 ref.

Descriptors: *DDT, *Brook trout, *Fish physiology, *Fish behavior, Chlorinated hydrocarbon pesticides, Acclimatization.
Identifiers: Salvelinus fontinalis, Sublethal effects, *Central nervous system, *Cold-blocking temperature, Thermal acclimation mechanism, *Avoidance responses.

When brook trout are exposed for 25 hours to sublethal doses of DDT, the cold-blocking temperature for a simple reflex, which shows lability related to thermal history, is altered in a way suggesting that DDT is affecting the thermal acclimation mechanism. Sublethal dosage of DDT also prevents the establishment of a visual conditioned avoidance response. (Sjolseth and Katz-Washington)
W70-05430

EVALUATING RISKS OF PESTICIDES TO FISH,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05A.
W70-05431

DISTRIBUTION OF THE ABALONE (HALIOTIS MIDAE) AND THE EFFECT OF TEMPERATURE ON PRODUCTIVITY,
South African Dept. of Industries, Cape Town.
G. G. Newman.
Division of Sea Fisheries, Investigational Report No 74, 1969. 7 p, 4 fig, 2 tab, 16 ref.

Descriptors: *Water temperature, Thermal stress, Commercial shellfish, Distribution, *Distribution patterns, Aquatic productivity, Comparative productivity, Environmental effects, *Growth rates, *Shellfish.
Identifiers: South Africa, *Abalone, *Haliotis midae, Recruitment, Maximum size, Size composition.

(Haliotis midae) was recorded to a maximum depth of 75 feet along the South African coast between Qora River and St. Helena Bay. Abalone are usually aggregated rather than evenly distributed on the bottom and the geographic range could be divided into three areas in which the productivity of stocks differs. These areas have different mean annual temperatures, which are sufficient to influence the maximum size, growth rate, onset of sexual maturity and spawning intensity of abalone. Larger abalone were associated with the colder areas but in the cold area productivity was low. Differences in some of these parameters are in turn shown to contribute to the different levels of productivity recorded in the three areas. (Sjolseth-Washington)
W70-05432

DETECTION OF TOXICITY OF AFLATOXINS, STERIGMATOCYSTIN, AND OTHER FUNGAL TOXINS BY LETHAL ACTION ON ZEBRA FISH LARVAE,
Department of National Health and Welfare, Ottawa (Ontario). Food and Drug Research Lab.
Z. H. Abedi, and P. M. Scott.
Journal of the Association of Official Analytic Chemists, Vol 52, p 963-969, Sept 1969. 2 tab, 2 fig, 49 ref.

Descriptors: *Fish toxins, *Bioassay, *Toxicity, Fish kill, Mortality.
Identifiers: *Fungal toxins, *Zebra fish larvae, Brachydanio rerio, *Sterigmatocystin, Gliotoxin, Aflatoxin B2, Aflatoxin G1, Aflatoxin G2, Aflatoxin B1, Morphological effects, Stemphone.

The effects of 13 fungal toxins (and one derivative) on the larvae of zebra fish, Brachydanio rerio (Hamilton-Buchanan), were investigated. The most toxic were sterigmatocystin, gliotoxin, and aflatoxin B1, which were lethal at concentrations of less than 1 ug/ml. Aflatoxins B2, G1, and G2, stemphone, diacetoxyscirpenol, ochratoxin A, aspertoxin, and patulin also showed toxicity to the larvae, while aflatoxin B1 hemiacetal, penicillic acid, and griseofulvin were non-toxic at the levels tested. Specific morphological effects were noted with sterigmatocystin, aflatoxins, and stemphone. The usefulness of zebra fish larvae as bioassay test organisms for fungal toxins is discussed. (Sjolseth-Washington)
W70-05433

CYANIDE POLLUTION AND EMERGENCY DUTY TRAIN WRECK; DUNREITH, INDIANA; JANUARY, 1968,
Indiana State Board of Health, Indianapolis. Div. of Sanitary Engineering.
Samuel L. Moore, and Stephen R. Kin.
Purdue Univ, Engineering Bulletin No 132 (Pt 1), p 583-600, 1968. 2 ref, 2 fig, 4 append.

Descriptors: *Public health, *Fishkill, *Water pollution effects, Water quality control, Water pollution treatment, *Water pollution control, Monitoring, On-site investigations, Bioassay.
Identifiers: *Cyanide pollution, Acetone cyanohydrin, Ethylene oxice, Methyl methacrylate, Dunreith (Ind).

A train wreck resulted in the spillage of acetone cyanohydrin, vinyl chloride, ethylene oxide and methyl methacrylate and the subsequent loss of thousands of fish. The analytical tests for cyanide (phenolphthalin test) made on the receiving stream and on fish in the steam and in live boxes show that free cyanide was lethal to fish at concentrations above 0.1 mg/l, was lethal to most game fish at 0.05 to 0.1 mg/l, and to some fish at concentrations as low as 0.03 mg/l. It was found that addition of calcium hypochlorite to cyanide polluted streams converted cyanide to cyanate and thus protected the water quality. (Sjolseth-Washington)
W70-05434

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
For primary bibliographic entry see Field 05B.
W70-05453

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-05465

ALGAL GROWTH AND DECOMPOSITION: EFFECTS ON WATER QUALITY, NUTRIENT UPTAKE AND CHEMICAL COMPOSITION OF ALGAE IN BATCH CULTURE,
Kentucky Water Resources Inst., Lexington.
Edward G. Foree, and John S. Tapp, Jr.
Available from the Clearinghouse as PB-190 801, $3.00 in paper copy, $0.65 in microfiche. Research Report No. 26, Water Resources Institute, University of Kentucky, Lexington, Kentucky, March, 1970. 76 p, 6 tab, 19 fig, 43 ref. OWRR Project A-021-KY.

Descriptors: *Eutrophication, *Algae, *Nutrient requirements, Chlorophyta, Cyanophyta, Cycling nutrients, Nitrogen, Phosphorus, Chemical analysis, Proteins, Carbohydrates, Lipids.
Identifiers: *Algal growth, Nutrient uptake, Chemical composition, Algal decomposition.

The chemical composition of algae grown in batch culture depends mainly on environmental conditions, nutrient availability, presence of predators, cell age, and species. The effects of nutrient availability and cell age on the composition of three unialgal cultures (algae + bacteria) and one heterogeneous culture (algae + bacteria + microscopic animals) were evaluated. The cultures were grown in batch culture under both nutrient-abundant and nutrient-deficient conditions and the changes in compositions were observed. Luxurious uptake, where nutrients are incorporated into cellular protoplasm at levels greater than those necessary for growth, and super-luxurious uptake, where some nutrients are stored rather than converted into algal protoplasm, were observed. The commonly used model for calculating the weight percentage of protein was inaccurate when super-luxurious uptake occurred. Composition of the cultures was generally characterized by protein synthesis during the nutrient-abundant growth phase, by a fluctuating composition during transition from nutrient-abundant to nutrient-deficient growth, and by lipid and/or carbohydrate synthesis and the establishment of a relatively constant composition during the nutrient-deficient growth phase.
W70-05469

TECHNICAL APPROACHES TOWARD EVALUATING ESTUARINE POLLUTION PROBLEMS,
Public Health Service, Portland, Oreg. Div of Water Supply and Pollution Control; and Washington State Dept. of Fisheries, Brinnon. Shellfish Lab.
A. F. Bartsch, R. J. Callaway, R. A. Wagner, and C. E. Woelke.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 693-700, 1967. 8 p, 13 fig, 3 tab, 23 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Estuaries, *Washington, Pulp wastes, Water quality, Salmon, Oysters, Bioassay, Analytical techniques, Salmonids, Research and development, Oceanography.
Identifiers: *Estuarine pollution.

Field investigations were undertaken to determine the effects of pulp and paper mill wastes on water quality at Everett, Bellingham, Anacortes, and Port Angeles, Washington. The research program required a coordinated effort of oceanographers, biologists, engineers, and others. Pulp and paper mill wastes occur at points where the juvenile salmonids and oysters are found. Three biological studies discussed in this paper are: (1) oyster larva bioassays for the Bellingham-Samish and Port Angeles areas; (2) adult oyster mortality, growth and conditions index for the Bellingham-Samish area; and (3) live box bioassays with juvenile solmonids for the Everett area. (Carstea-USGS)
W70-05538

BIOLOGICAL PRODUCTION AND DISTRIBUTION OF CARBON DIOXIDE IN WOODS HOLE WATERS,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 05A.
W70-05540

5D. Waste Treatment Processes

THE OPERATION OF THERMAL POWER STATIONS IN RELATION TO STREAMS,
Central Electricity Generating Board, Leatherhead (England). Biology and Effluents Section.
F. F. Ross.
Institute of Sewage Purification, January, 1959, p 16-29, 4 fig, 2 tab.

Descriptors: *Cooling water, *Dissolved oxygen, Cooling towers, *Thermal pollution, Fish, Temperature, Chlorination.
Identifiers: Bottom mud deposits, Ash disposal.

The paper is divided into three parts, small discharges, disposal of heat and results of recent research. Air used for combustion of coal or oil becomes converted to flue gas. Washing the gases to remove sulphur oxides does not benefit the atmosphere to an extent that is in any way detectable by the established methods of measuring sulphur pollution; on the other hand it necessarily contributes to the pollution of the river. Instead of using river water, a new process of gas washing under trial at Nottingham makes use of ammoniacal liquor from gas works. Condenser tubes, being slightly warmer than the water which passes through them, become coated with slime growths of bacteria and fungi. This reduces heat transfer, increases the temperature of condensation, reduces the efficiency of power generation, and increases the heat that has to be disposed of. Chlorination is nearly always the most effective remedy. It is common belief that when water is warmed, some of the dissolved oxygen is driven out of it. This can only be true if the water is saturated, and even then it may remain supersaturated until it has cooled again. BOD and U-V Tests indicate a significant reduction of total organic matter, even in one passage through the tower. For the disposal of heat, the most economical temperature rise in cooling water is 14-18 deg F; more makes the water too warm and reduces efficiency, while less means that more water has to be pumped and wastes power. A temperature of 93 deg F may be taken as upper-limit for fish. An instantaneous change of about 15 deg F will adversely affect coarse fish. (Upadhyaya-Vanderbilt)
W70-05051

A SOLUTION OF THE COTTON SIZING WASTES PROBLEM,
Hercules Powder Co., Wilmington, Del.
For primary bibliographic entry see Field 05B.
W70-05075

METABOLIC UPTAKE OF PHOSPHORUS BY WASTEWATER ORGANISMS,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Gilbert V. Levin, and Joseph Shapiro.
Journal Water Pollution Control Federation, Vol 37, No 6, p 800-821, 1965. 22 fig, 3 tab, 24 ref.

Descriptors: *Waste water treatment, *Phosphorus, Metabolism, Dissolved oxygen, Uptake, Sludge treatment, Energy transfer, Aeration, Hydrogen ion concentration, Biodegradation, Sewage, Eutrophication.
Identifiers: Phosphate stripping, Sludge solids, Plant-scale studies, ATP, Carbohydration, Metophosphate, Biological oxidation.

Inorganic orthophosphate is a prerequisite for energy transfer in all living organisms. Orthophosphate enters metabolic chain of reaction when adenosine triphosphate (ATP) is created or regenerated. Phosphorus, rather than available carbon, might be limiting in biological oxidation of carbohydrates. Phosphate removal is aided by granules in bacteria, algae, and fungi storing metaphosphate. Modifying activated waste systems promotes higher phosphate removal by sludge organisms. Laboratory experiments with mixed sewage liquids indicate a greater phosphate uptake with carbohydrate added. Sludge is the active fraction of mixed liquor adsorbing orthophosphate. Aerated sludge removes greater amounts of phosphate; aeration rate determining ultimate phosphate adsorption. An optimum rate of aeration was 17 milliliter/second applied to 1500 milliliter portion of mixed fluid. Using pure oxygen instead of air increased uptake at same uptimum rate. Substantial orthophosphate leakage occurs without aeration. Optimum pH is 7-8 for phosphate removal; removal efficiency may be significantly improved by stripping phosphate from sludge by lowering pH before recycling. Practical application of metabolic uptake of phosphorus depends upon sludge organisms adsorbing more phosphate than they need for growth. Application of laboratory work to plant-size operation found increased aeration improves orthophosphate uptake. (Bannerman-Wisconsin)
W70-05083

MICROBIOLOGY OF DOMESTIC WASTES. III. METABOLISM OF LAS-TYPE DETERGENTS BY BACTERIA FROM A SEWAGE LAGOON,
Manitoba Univ., Winnipeg. Dept. of Microbiology.
Harvest Halvorson, and M. Ishaque.
Canadian Journal of Microbiology, Vol 15, p 571-576, 1969. 5 fig, 1 tab, 21 ref.

Descriptors: *Sewage lagoons, *Biodegradation, *Domestic wastes, Detergents, Metabolism, Temperature, Bacteria, Waste treatment, Seasonal.
Identifiers: *Linear alkylate sulfonate, *LAS, Alkyl benzene sulfonate, ABS, Methylene blue active substance, Commercial LAS, Liqui-nox, Cold weather.

Effects of physical parameters on metabolism rate of alkyl benzene sulfonate (ABS) and linear alkylate sulfonate (LAS)-detergents such as Liqui-nox, commercial LAS, C-sub-11.3 (mean chain length 11.3 carbon atoms) LAS, C-sub-13.3 carbon LAS, alpha-11 LAS, and alpha-14 LAS are described. Biodegradability of the detergents was studied using bacteria from a sewage lagoon. LAS degraded about 97.5% at 25C over 120 hours. Slight differences in biodegradability were not significant. The metabolism of alpha-14 LAS and Liqui-nox was studied as function of temperature. From 25C to 10C the time required for utilization increased 2.5. No usage of either detergent occurred at 2C over 12 days. Bacteria recovered from

under the ice-cover were not able to degrade either alpha-14 LAS or Liqui-nox at 2C even in the presence of oxygen. The liqui-nox metabolism was measured as a function of aeration; it was not catabolized in the absence of oxygen. Resident methylene blue active substance (MBAS) in a lagoon and its metabolic rate by bacteria were studied as a function of seasonal changes. Between June and October 1966 concentrations of MBAS varied from 4.2 to 8.2 ppm. The significance of the results is discussed with respect to management of sewage lagoons where seasonal changes occur. (Haskins-Wisconsin)
W70-05100

A STUDY OF WATER POLLUTION CONTROL IN THE TEXTILE INDUSTRY OF NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
Dale I. Gramley, and Milton S. Heath, Jr.
Available from the Clearinghouse as PB-190 572, $3.00 in paper copy, $0.65 in microfiche. Report No. 21, WRRI-UNC, January 1970. 94 p. OWRR Project A-004-NC.

Descriptors: *Textiles, Water pollution sources, *Industrial wastes, *Waste treatment, Water utilization, Waste water reclamation, *Water pollution control, *Water reuse, Water quality.
Identifiers: *North Carolina.

This study is a segment of a larger project - Comparative Analysis of Selected State Water Pollution Control Programs - and is intended to add a further dimension through an economic analysis of waste treatment practices of the textile industry in North Carolina. The opening chapters of the report review North Carolina textile history, general economic rationale of water pollution abatement, review of production processes and waste technology, and case studies of water utilization in textile plants. The report is introduced by a series of observations dealing with least cost solutions, textile economy, application of economic analysis to water quality management and role and effect of state water quality management programs. (Howells-North Carolina)
W70-05124

STUDY OF A WATER-VAPOR ELECTROLYSIS UNIT,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 05A.
W70-05134

UNIQUE TREATMENT PLANT FOR NORTH GEORGIA.
T. Maddox.
Water and Sewage Works, Vol. 109, p325, 1962.

Descriptors: *Industrial waste, *Waste treatment, *Treatment facilities, *Waste water treatment, Waste waters, Water pollution, Biological treatment, Aeration, Micro-organism.
Identifiers: *Textile mill wastes.

An industrial wastes treatment plant has been constructed for the Chicopee Manufacturing Corporation's textile factory at Gainesville, Georgia. Waste waters from this factory were discharged into Bailes Creek before pollution was increased by the construction of Lake Lanier. The new plant will provide single-stage biological treatment with aeration for up to 40 hours to enable the micro-organisms to become adapted to variations in the composition of the waste water, thus avoiding the need for further treatment. (Mattox and Livengood - North Carolina State Univ)
W70-05164

WHERE DOES RESEARCH STAND IN WATER POLLUTION.
H. G. Hanson, and B. B. Bergen.
Journal of the Water Pollution Control Federation, Vol. 33, p477-484, 1961.

Descriptors: *Separation techniques, Water pollution, Water pollution control.
Identifiers: *Research, Purification.

In this review three questions are answered: (a) who is doing research, (b) what is being done in research, and (c) what are the resources for doing research. Approximately 2/3 of all research is done by universities, and the remainder is done by industries, states, and municipalities. The research projects fall into 6 categories: (1) origin and behavior of wastes, (2) treatment of waste, (3) disposal of wastes, (4) stream monitoring and surveys, (5) treatment of water, and (6) conservation. The nation's developed resource for research in water supply and pollution control is extremely limited. The report includes discussions on accounting for all the wastes reaching streams, predicting the pollutional character of new wastes, adequate treatment of wastes, effective use of the receiving water, intelligent and effective monitoring of receiving waters, effective treatment of polluted water for reuse, and the problems of separation and purification. (Robinson-North Carolina State Univ)
W70-05165

FEASIBILITY STUDY FOR GLENDALE - LOS ANGELES WATER RECLAMATION PLANT (CONDENSATION),
Engineering Science, Inc., Oakland, Calif.; and Koebig and Koebig, Inc., Los Angeles, Calif.
For primary bibliographic entry see Field 03C.
W70-05254

ALGAL FLOCCULATION WITH SYNTHETIC ORGANIC POLYELECTROLYTES,
Notre Dame Univ., Ind. Dept. of Civil Engineering.
Mark W. Tenney, Wayne F. Echelberger, Jr., Ronald G. Schuessler, and Joseph L. Pavoni.
Applied Microbiology, Vol 18, No 6, p 965-971, 1969. 8 fig, 11 ref.

Descriptors: *Algae, *Flocculation, *Waste water treatment, Electrolytes, Chemical reactions, Electrochemistry, Resistivity, Chlorella, Scenedesmus.
Identifiers: *Polyelectrolytes, *Synthetic organic polyelectrolytes, Cationic electrolytes, Algal surface charge, Electrostatic repulsion, Dow C-31, Dow A-21, Nalco N-670.

Catonic, anionic, and nonionic synthetic polyelectrolytes were used in attempts to remove algae from waste waters. Under conditions of the study, flocculation of algae was caused only by cationic electrolytes. The mechanism of flocculation is interpreted as bridging phenomena between algal cells and the matrix of lineary extended polymer chains. The flocculation requires a reduction in the algal surface charge to a level at which the extended polymers can overcome electrostatic repulsion. The rate of application of cationic flocculants depends upon pH of the medium, algal concentration, and algal growth phase. (Wilde-Wisconsin)
W70-05267

CONVENTIONAL AND ADVANCED WASTE TREATMENT,
Los Angeles County Sanitation District, Calif.
For primary bibliographic entry see Field 03C.
W70-05277

TECHNICAL PROBLEMS CREATED BY REUSE,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 03C.
W70-05278

HOUSEHOLD WASTE WATER,
National Swedish Inst. for Building Research, Stockholm.
For primary bibliographic entry see Field 05B.
W70-05304

CONTINUOUS MICROBIOLOGICAL PURIFICATION OF WASTE-WATER FROM PAPER AND WALLBOARD INDUSTRIES,
Lund Inst. of Tech. (Sweden).
For primary bibliographic entry see Field 05F.
W70-05305

CONTRIBUTION BY COMMONWEALTH TO COST OF ABATING POLLUTION.

Pa Stat Ann tit 35, secs 701-703 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Sewage treatment, *Cost repayment, *Cost sharing, Water pollution, Financing, Construction costs, Operating costs, Maintenance costs, Replacement costs, Pollution abatement, Sewage, Local governments, Sewers, Pumping plants, Payment, Stream improvement, Cities, State governments, Legal aspects, Legislation, Costs.

Where constructed in accordance with the 1937 Clean Streams Program the Commonwealth of Pennsylvania will pay up to 2% of the cost of those sewage treatment plants acquired or constructed by municipal authorities or school districts. The word 'construction' shall include the construction of new treatment facilities and the altering or improving of existing treatment facilities. Determination of the amount of such contribution shall be made by the governor upon recommendation of the Secretary of Health. In cases where the treatment facilities are acquired or constructed by the State Public School Building Authority and thereafter leased to a local school district, payment from the Commonwealth toward the cost of operating, repairing or replacing the facilities shall be made to the school district. (Dearing-Florida)
W70-05353

BIODEGRADATION OF NITRILOTRIACETIC ACID IN AEROBIC SYSTEMS,
Wisconsin Univ., Madison. Water Chemistry Lab.
Bernhard H. Pfeil, and G. Fred Lee.
Environmental Science and Technology, Vol 2, No 7, p 543-546, 1968. 7 fig, 2 tab, 6 ref.

Descriptors: *Biodegradation, *Waste treatment, *Aerobic treatment, *Eutrophication, Water pollution control, Biochemical oxygen demand, Chemical oxygen demand, Activated sludge, Chemical analysis, Sewage treatment, Volumetric analysis, Wisconsin, Acclimatization, Dissolved oxygen.
Identifiers: *Nitrilotriacetic acid, NTA, Waste treatment biota, Madison (Wis), Nine Springs Treatment Works (Wis), University of Wisconsin, Mixed liquor suspended solids.

Because of role of phosphate detergents in eutrophication, search for suitable substitutes in receiving increasing emphasis. One proposed substitute, NTA (sodium salt of nitrilotriacetic acid), a strong complexing agent may have effects on biota of waste treatment processes. Because previous evidence regarding biodegradability of NTA was equivocal, study of its degradation in biochemical oxygen demand (BOD) test and laboratory activated sludge units was undertaken. Disappearance of NTA in activated sludge was quantitated by titration with copper salt in presence of sodium acetate, with or without indicators (catechol violet; murexide). In activated sludge, NTA was biologically degraded only after acclimatization of microorganisms to compound for one week. With NTA loadings up to 110 milligrams/liter, concentrations higher than normally expected in municipal sanitary wastewater, compound was easily degraded by acclimated organisms from secondary treatment processes. BOD (5 days) of NTA is zero unless organisms, utilized to seed determination, were similarly acclimatized. Oxygen in BOD test, seeded with acclimated organisms, was reduced below 0.05 milligrams/liter after 13 days in presence of 20 and 100 milligrams NTA/liter. In absence of NTA for periods up to 2 days, acclimated organisms did not lose ability to degrade compound. (Eichhorn-Wisconsin)

W70-05379

POLLUTION CONTROL CAN BE PROFITABLE,
Baldwin-Lima-Hamilton Corp., Philadelphia, Pa. Heat Transfer Engineering Dept.
John G. Gaydos, and Alfred N. Rogers.
Water and Wastes Engineering, November 1969, 2 p. 2 fig, 4 tab.

Descriptors: *Water pollution control, *Profit, Water reuse, Desalination, Waste water treatment, Application methods, Chemical wastes, Wastes, Industrial water, Industrial wastes, Income, Effluents.
Identifiers: Chemicals manufacture wastes, Feed conditioner, Flash distillation unit, Byproducts.

A hypothetical factory which manufactures fine chemicals, requires substantial quantities of comparatively pure water and has a plant effluent of roughly 2% dissolved salts is considered. The proposed solution involves a multi-stage flash distillation unit and a crystallizer. Conditioned effluent is fed to a multi-stage flash distillation unit which recovers 88% of the water content and returns ultrapure distillate to the chemical plant. The blowdown from the distillation unit proceeds to a crystallizer which recovers the balance of the water content. Solids discharged from the crystallizer are centrifuged, dried, and packaged for sale as highway de-icer. The income in dollars per day and the quality of valuable byproducts recovered are presented. In balancing costs versus value of recovered products, a profit of 12.9% (20-year life) is derived from the original investment. (Haskins-Wisconsin)
W70-05392

EFFECTS OF LOADING ON A BIOLOGICAL TERITIARY TREATMENT SYSTEM,
Washington Univ., Seattle. Dept. of Civil Engineering.
H. Kirk Willard, and D. A. Carlson.
Presented at the 23rd Annual Purdue Industrial Wastes Conference, Lafayette, Indiana, May 9, 1968. 25 p. 12 fig, 20 ref.

Descriptors: *Effluents, *Waste treatment, *Tertiary treatment, Treatment facilities, Biological treatment, Phosphorus, Nitrogen, Biochemical oxygen demand, Rotifers, Analytical techniques, Model studies.
Identifiers: Particulate scrubbing system, Aufwuchs biocoenose, Ciliates, Bacterial grazers, Suspended solids removal.

A two-phase biological tertiary waste treatment system is proposed for rapid removal of suspended solids and carbonaceous material. The system consists of a biosynthesis step and a particulate scrubbing unit, called an aufwuchs biocoenose. Data collected from a continuous flow bench scale model indicated that the activity of aufwuchs organisms, under imposed conditions, could be described by a mathematical equation relating loading in terms of bacterial suspended solids concentration and stationary surface area. Aufwuchs maximum growth rate constant was 0.026/hour and the half-rate substrate concentration was 6.2 milligram/liter. A biomass yield of 16% of the influent suspended solids for the particulate feeders produced a low effluent solids concentration of 0.069 milligram suspended solids/milligram biochemical oxygen demand (BOD) removed. Total dissolved organic carbon was destroyed above 90% in the bacterial and aufwuchs unit. Similar removal values of 90% to 94% were measured for BOD. Decrease of both organic carbon and BOD were higher at lower loading rates. Most nitrogen compounds were oxidized to nitrates with percent of nitrification decreasing with increasing loadings. Phosphates were not removed except for the amount incorporated into wasted cell biomass ranging in magnitude from 22 to 36%. (Haskins-Wisconsin)
W70-05419

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
Richard R. Dague, and Kenneth J. Kline.
Available from the Clearinghouse as PB-190 830, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute Report No 69-4, Iowa University, Project Completion Report, June 30, 1969. 195 p, 99 fig, 20 tab, 19 ref, 4 append.

Descriptors: *Farm wastes, *Confinement pens, *Waste treatment, *Waste disposal, Lagoons, Water pollution control, Water pollution sources.
Identifiers: Feedlot wastes, Waste management.

The effects of hydrologic factors on the control of runoff from open feedlots were studied. Management and treatment techniques are discussed and evaluated. Rainfall, runoff, and streamflow are the primary factors to consider in managing cattle feedlot runoff. The nature, volume, and rate of delivery of runoff are directly related to rainfall. Storage requirements depend upon the volume of runoff, whereas the retention pond discharge rate should be proportional to streamflow. Terraces and retention ponds will reduce the pollution from cattle feedlot runoff. Application to land appears to be the most practical method of disposal for both the solids and the liquid. When applied to agricultural land, the waste has some economic value. Retention ponds may not remove sufficient amounts of suspended solids, BOD, COD, and nutrients to provide safe effluents for disposal to streams. (Knapp-USGS)
W70-05465

REUTILIZATION OF WASTEWATER RECYCLED THROUGH GROUNDWATER, VOLUME 1 AND 2.
Eastern Municipal Water District, Hemet, Calif.

Available from the Clearinghouse as PB-190 790 (Vol. I), and PB-190 791 (Vol. II), $3.00 each in paper copy, $0.65 each in microfiche. Progress Report to Federal Water Pollution Control Administration for Project 16060, December 1968. Volume 1 - 125 p, 45 fig, 20 tab, 13 ref, Volume 2 - 87 p, 61 ref, 3 append. Grant FWPCA 16060 DDZ --- 12/69.

Descriptors: *Artificial recharge, *Water reuse, *California, Water yield, Infiltration, Water spreading, Pit recharge, Safe yield, Water balance, Hydrogeology, Data collections, Hydrologic data, Groundwater movement, Water quality, Water levels, Water supply, Water utilization, Surveys, Geophysics.
Identifiers: San Jacinto Valley (Calif).

The water quality factors involved in the recharging of the San Jacinto Basin, California are evaluated so that the overall operation may be conducted in a manner to provide adequate protection of groundwater quality while permitting reclamation of wastes for regional water conservation. Another objective is to study the benefits to the salt balance problem caused by recharging. In the previous situation, some effluents were discharged to the San Jacinto River area and some were used as irrigation water. With recharge there is a significant reduction in evapotranspiration losses, thus improving groundwater quality by diluting the dissolved salts. The safe groundwater yield is limited to approximately 11, 205 acre-feet/year. The volumes of water reclaimed and put underground to replenish the overdraft now average approximately 1430 acre-feet/year. Withdrawals now approximate 12,000 acre-feet/year, and importation of Colorado River water approximates 1900 acre-feet/year. Inflow of salt into the basin is now estimated at 5800 ton/year; 3900 ton/year from inflowing groundwater and 1900 ton/year from imported Colorado River water. (Knapp-USGS)
W70-05466

REMOVAL OF SELECTED CONTAMINANTS FROM WATER BY SORPTION OF COAL,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
Paul H. King, Francis R. McNeice, and Pierre S. Warren.
Available from the Clearinghouse as PB-190 802, $3.00 in paper copy, $0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Bulletin 32, November 1969. 75 p, 34 fig, 3 tab, 37 ref. OWRR Proj No A-015-VA.

Descriptors: *Tertiary treatment, *Phosphorus compounds, *Nutrients, *Pesticides, *Water pollution control, Eutrophication, Algae, Filtration, Sorption, Flocculation, Coal, Activated carbon.
Identifiers: Coal contact processes, Pesticide removal.

Removal or limitation of soluble phosphorus in wastewater effluents is a key factor in alleviating the aesthetic and economic problems associated with excessive algal growth. Very dilute concentrations of long-lived pesticides can in time be lethal to animals exposed to them. If dangerous or potentially dangerous concentrations of pesticides exist in water utilized for human consumption, methods must be developed to remove them easily and economically. Activated carbon is very effective in adsorbing organic compounds from dilute solution. The high cost of this adsorbent, however, often prohibits its use in large-scale treatment processes. Coal is relatively low in cost and thus is an attractive filter media if the removal of dissolved material by sorption can be accomplished concurrently with the elimination of suspended solids by filtration. Although coal is a poorer sorbent than is activated carbon, it is considerably more economical and can be incinerated after exposure to a wastewater stream. The extent of uptake of selected phosphorus containing compounds and synthetic organic pesticides by coal were evaluated in both batch continuous flow operations. The kinetics of the uptake process as well as the capacity of the coal for the sorbate at equilibrium are reported. (Knapp-USGS)
W70-05470

5E. Ultimate Disposal of Wastes

SUBSURFACE DISPOSAL OF INDUSTRIAL WASTES,
Michigan State Geological Survey, Lansing.
Robert E. Ives, and Gerald E. Eddy.
Interstate Oil Compact Commission Study, Oklahoma City, June 1968. 109 p, 6 fig, 3 tab, 62 ref, 3 append.

Descriptors: *Waste water disposal, *Industrial wastes, *Injection wells, Surveys, Aquifers, Hydrogeology, Legal aspects, Water law, Water chemistry, Water pollution, Geology, Regulation, Monitoring, Well regulations.
Identifiers: Waste disposal wells.

Underground waste disposal policies and practices in the U.S. are compiled and reviewed. A questionnaire was compiled and sent out to establish information on the nature, seriousness, legal aspects, and method of handling these problems as they exist in each of the states. Another questionnaire was sent out that dealt specifically with individual subsurface waste disposal wells. A short discussion of pollution problems includes information on the nature and seriousness of the pollutants and the treatment methods currently being used. Physical considerations of use of underground reservoirs may affect other values and other uses of these reservoirs for reasonable purposes. Legal considerations and resulting complications are discussed. A summary coverage of disposal systems and disposal wells now in use in the various states includes comments on state policies, regulations and enforcement. Recommended practices and procedures in the establishment of guidelines concerning initial processing of applications, drilling, monitoring, and final abandonment of disposal wells are given. (Knapp-USGS)

W70-05181

MANAGEMENT OF CATTLE FEEDLOT WASTES,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 05D.
W70-05465

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
For primary bibliographic entry see Field 05G.
W70-05467

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 05G.
W70-05468

PERSPECTIVE ON THE REGULATION OF UNDERGROUND INJECTION OF WASTEWATERS,
Ohio River Valley Water Sanitation Commission, Cincinnati; and Federal Water Pollution Control Administration.
For primary bibliographic entry see Field 05G.
W70-05521

5F. Water Treatment and Quality Alteration

PHYTOPLANKTON AS AN AGENT OF THE SELF-PURIFICATION OF CONTAMINATED WATERS,
Foreign Technology Div., Wright-Patterson AFB, Ohio.
G. G. Vinberg, and T. N. Sivke.
Available from the Clearinghouse as TT-67-62992, and AD-659 310, $3.00 in paper copy, $0.65 in microfiche. Translation by Foreign Technology Division, Wright-Patterson Air Force Base, FTD-MT-66-13, August 18, 1967, 37 p. Trans. from Trudy Vsesoyuznogo Gidrobiologicheskogo Obshchestva, Vol 7, p 3-23, 1956.

Descriptors: *Phytoplankton, *Self-purification, *Waste water (Pollution), *Water purification, Algae, Sewage, Anaerobic, Oxygen, Nitrification, Coliforms, Ponds, Climates, Photosynthesis, Productivity, Symbiosis, Reservoirs, Lakes, Reaeration, Seston, Chlorophyll, Cycles, United States, Chlorella, Biochemical oxygen demand, Oxidation lagoons, California, Texas, Depth, Retention, North Dakota, Ice, Snow, Carp, Salmon, Irrigation, Filtration, Organic matter, Ammonia, Hydrogen ion concentration, Antibiotics, Symbiosis, Euglena, Light intensity, Nutrients, Temperature.
Identifiers: Piscicultural ponds, Svisloch' River (USSR), Minsk (USSR), England, Oscillatoria, Australia, Santa Rosa (Calif), Lyublin (USSR), Lyuberets (USSR), Munich (Germany), Chlorella pyrenoidosa, Bichoromate, Dry weight, B coli communae, Euglene gracilis, Protococcales.

Planktonic algae grown on a large scale on undiluted city sewage sharply accelerates self-purification processes; it is expressed in faster initial lowering of the biochemical oxygen demand, early termination of the anaerobic phase, appearance of free oxygen, and in the accelerated onset of nitrification. Accumulation of a large quantity of organic substances synthesized by the algae in the composition of the bodies of the living cells is not reflected in the magnitude of the biochemical oxygen demand. The death rate of coliform bacteria increased sharply with the large-scale development of green algae in self-cleaning sewage. Euglena and Chlorella are compared. Ponds, filled with undiluted sewage, are the simplest method to use green organisms as agents of self-purification and is an especially effective method of water reclamation, particularly applicable to warm, dry, climatic regions. Further study of favorable conditions for development of photosynthesizing plankton organisms will alleviate problems in large-scale cultivation of algae as a method of utilizing sewage and particularly should clarify the applicability of using algae grown on sewage to increase the productivity of piscicultural ponds. (Jones-Wisconsin)
W70-05092

HYDRAULICS OF STRATIFIED FLOW - SECOND PROGRESS REPORT SELECTIVE WITHDRAWAL FROM RESERVOIRS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-05251

THE LIMITED WAR ON WATER POLLUTION,
Gene Bylinsky.
Fortune, Vol. 81, No. 2, pp. 102-107, 193-195, 197, Feb. 1970. 10 p, 5 fig.

Descriptors: *Impaired water quality, *Water pollution, Water pollution sources, Water treatment, Water quality act, Sewage treatment, Governments.

The federal government, along with state governments, are increasing their efforts and expenditures towards stopping water pollution and cleaning up polluted waters. The volume of pollutants keeps expanding while water supply stays basically the same. Therefore, more intervention will be required to just keep water pollution from getting worse. A diagrammatic view of water treatment is presented. The following aspects of water pollution are discussed; the demand for oxygen in water, what level of cleanliness of water is desired, sewage treatment by mechanical means, lack of treatment for algal and foam, coping with bacteria, turning brackish water into potable water, coping with sludge, drafting of water quality standards, and finally, the lack of imagination of the federal approach to water pollution control. (Grossman-Rutgers)
W70-05280

CONTINUOUS MICROBIOLOGICAL PURIFICATION OF WASTE-WATER FROM PAPER AND WALLBOARD INDUSTRIES,
Lund Inst. of Tech. (Sweden).
Ivar H. Sanick, and Gunnar Sjostrom.
Available from the Clearinghouse as PB-188 194, $3 in paper copy, 65 cents in microfiche. Acta Polytechnica Scandinavica, Ch 86, Royal Swedish Academy of Engineering Sciences, Stockholm, Sweden, 1969. 34 p, 11 tab, 13 fig, 10 ref.

Descriptors: *Pulp wastes, Pulp and paper industry, Wood wastes, *Water purification, *Fungi, Metabolism, Enzymes, Carbohydrates, Biological treatment.
Identifiers: *Coniophora cerebella, Sweden.

The fast growing strain of Coniophora cerebella called 'G' and isolated (I.S.) by ultra sound treatment of a suspension of the original strain of C. cerebella, has proved to tolerate extreme environmental conditions. After more than 4 years the G-strain has not shown any tendency to degenerate in the presence of other soil micro-organisms. With the faster growth and spread it is not surprising to find that also the sclerotia formed quicker than with the original strain. The sclerotium formed has been closer investigated by micro-photography of frozen sections. Growing on different kinds of wood it was found that the C. cerebella G will grow twice as fast on cross-cuts of pine as on cross-cuts of common birch. Tests with waste-water have shown that in practice nothing is to be gained by adjusting the original pH-values prior to the enzymatic break-down on fibres and dissolved carbohydrates. In purification tests of waste-water the pH will rise from 3.8 to 5.9 after a flow distance of 72 m over bed. The BOD of waste-water after purification and correction for water evaporation had dropped from 2150 mg/l to 234 mg/l after a flow distance of 104 m over bed. The corresponding drop in COD was from 5590 mg/l to 517 mg/l.
W70-05305

HEALTH AND SAFETY (WATER SUPPLY).

Pa Stat Ann tit.35, secs 711-716 (1964), as amended (Supp 1969).

Descriptors: *Pennsylvania, *Water works, *Water supply, *Potable water, Water sources, Permits, Public health, Public utilities, Administrative agencies, Planning, Surveys, Construction, Judicial decisions, Legal aspects, Water purification, Water treatment, Equipment, Water distribution (Applied), Water quality, Standards, Legislation, Regulation, Water works, Water quality control.

Any person, company or corporation supplying water to the public must file with the Commissioner of Health a copy of the plans of their waterworks and a description of the source of their water supply. No additional source of supply may be used without a permit from the Commissioner, nor may waterworks be constructed without a permit. Permits will only be granted if the source of water supply is approved. Decisions of the Commissioner may be appealed to the courts in accordance with the specified procedures. The Department of Health may take such action as is necessary to insure the potability of water and the maintenance of proper treatment equipment by every permittee. Upon the failure of any permittee to meet Department standards of potability or treatment equipment, the Department may, by court permission, take over the permittee's facilities and make the needed corrections. The cost of all such corrections shall be borne by the delinquent permittee. (Dearing-Florida)
W70-05354

WATER POLLUTION CONTROL AND PUBLIC WATER SUPPLY.
For primary bibliographic entry see Field 05G.
W70-05356

HEALTH AND SAFETY (BOTTLED WATER).
Pa Stat Ann tit. 35, secs 1001-1006 (1964).

Descriptors: *Pennsylvania, *Water pollution, *Potable water, *Public health, Water delivery, Water pollution control, Water quality, Mineral water, Spring waters, Permits, Administrative agencies, Inspection, Water supply, Regulation, Legal aspects, Legislation, Water, Water quality control.
Identifiers: *Bottled water.

No polluted or otherwise impure or injurious water may be bottled or sold for drinking purposes. Annual permits to be issued by the Department of Health are required for the manufacture and sale of bottled water. These permits may be denied or revoked by the Department if, after thorough investigation and inspection, the water so bottled and sold is found to be impure or injurious to the public health, or if it bears evidence of potential pollution. The Department may establish rules and regulations for the effective enforcement of these provisions. Violation of these regulations or of this law shall constitute a misdemeanor. This act shall not apply to the manufacture or sale of carbonated beverages or still drinks. (Dearing-Florida)
W70-05368

ALGAE IN WATER SUPPLIES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
C. Mervin Palmer.
U S Public Health Service Publication No 657, 1959. 88 p. 55 fig, 13 tab, 170 ref, 6 plates, appendix.

Descriptors: *Algae, *Water supply, *Control, Taste, Odor, Filters, Plankton, Water pollution, Surface waters, Reservoirs, Control, Bibliographies, Analytical techniques, Diatoms, Sampling, Physicochemical properties, Centrifugation, Microscopy, Nets, Nannoplankton, Pigments, Chlorophyta, Cyanophyta, Chrysophyta, Rhodophyta, Euglenophyta, Slime, Color, Corrosion, Distribution systems, Coagulation, Water softening, Toxicity, Marine algae, Fresh water, Parasitism, Water treatment, Indicators, Waste treatment, Copper sulfate, Algicides, Photosynthesis.
Identifiers: *Identification, *Significance, Algal key, Clump count, Desmids, Flagellates, Mesoplankton, Microplankton, Pseudoplankton, Cryptophyceae, Volvocales, Industrial uses, Clean water, Genus, Species, Touch sensation.

Continued surveillance of algal populations under a planned and uniform approach is needed to put information in an understandable and useful form. This manual is an attempt to appraise nuisance organism problems and furnish information for remedying some difficulties. It deals with the ecology and life history of algae and gives information on filter clogging, mat-forming algae, attached forms, algicides, and algal control. Large quantities of algal material cause serious difficulties in water treatment plants. Certain diatoms almost invariably reduce the length of filter runs. Synura, is a taste and odor producer. Low concentrations of most algae are often an asset in raw waters. A simplified key of 289 species with drawings of most important is given. The algae are considered and displayed according to their significance to sanitary scientists and technicians rather than with regard to their evolutionary relationship. Most algae of importance in water supplies may be characterized in four general groups: blue-green algae, green algae, diatoms, and pigmented flagellates. A few miscellaneous forms do not fit into these four groups. Polluted water algae, clean water algae, plankton, and other surface water algae are included. (Jones-Wisconsin)
W70-05389

STATE BOARD OF HEALTH.

Del Code Ann tit 16, sec 122 (1953), as amended, (Supp 1966).

Descriptors: *Delaware, *Sanitation, *Administrative agencies, *Public health, Legislation, Legal aspects, Administration, Environmental sanitation, Recreation, Sanitary engineering, Social aspects, Urbanization, Water quality, Water pollution, Drainage, State governments, Sewage disposal, Recreation facilities.

The State Board of Health has the duty to : (1) provide for the sanitary protection of all water supplies which are furnished to and used by the public; (2) provide for the proper collection, storage, and disposal of sewage by public authorities and individuals; (3) provide for the sanitary control of public swimming and bathing places, and (4) regulate plumbing in the interests of public health. The Board of Health advises officers of the state, county, and local governments in regard to drainage and the location, drainage, ventilation, and sanitary provisions of any public institution, building or public place. (Powell-Florida)
W70-05448

5G. Water Quality Control

THERMAL POLLUTION CONTROL - NEED FOR ACTION,
J. I. Bregman.
Thermal Pollution Symposium of the Cooling Tower Institute Meeting, New Orleans, Louisiana, January 30, 1968, p 1-8.

Descriptors: *Thermal pollution, *Thermal power, *Temperature, *Power plants, *Aquatic life, Water quality act, Water quality control, Nuclear power plants, Standards.
Identifiers: Interstate standards, Intrastate standards, Power plant licenses.

By 1980, one-fifth of the total fresh water runoff of the U.S. will be used for cooling. The 95% of thermally-generated electricity that is presently produced by fossil fuel will decline to 65%, and the nuclear plants require 40% more condenser water for a given temperature rise than fossil fuel. The result will be larger, more concentrated loads of waste heat, which threaten the survival of the aquatic life in the streams on which power plants are located. The 1965 Water Quality Act has resulted in the setting of interstate water quality standards in all states, with different types of waters (warm, cold, marine) and different uses assigned different limits. Those standards will be enforced by the states, aided by the federal government if necessary. Many states have set standards for intrastate streams which include temperature changes. The federal government is working to set an example by controlling thermal wastes from nuclear reactors owned by the Atomic Energy Commission. Proposed controls include issuing licenses for construction of plants only when thermal pollution is prevented and providing department review of pending power applications. (Speakman-Vanderbilt)
W70-05052

WISCONSIN WATER RESOURCE PROBLEMS,
Wisconsin Dept. of Natural Resources, Madison.
L. P. Voigt.
Wisconsin Conservation Bulletin, p 3-5, January-February 1970. 2 photos.

Descriptors: *Water quality, *Wisconsin, Phosphorus, Pulp and paper industry, Algae, Aquatic weeds, Recreation, Groundwater, Fish, Flood plains, Irrigation, Pesticides.
Identifiers: Fox River Basin (Wis), FWPCA.

Wisconsin's water problems relate to water quality and not quantity. The southeastern and eastern parts of the state are particularly problematic due to population and industrial concentrations, and subquently increasing demands for quality water for recreation use. The pulp and paper industry represents the largest waste source, with four times the biochemical oxygen demand of municipal wastes. Any solution will demand that the product prices reflect total costs, including environmental damages. Federal allocation funds for industrial and municipal waste treatment plants were only 1/3 of the authorized amount, thus the state's effectiveness in pollution control is hampered. In the past, the problems of silt, nutrients, and pesticides have been tacked by education programs, voluntary action, and cost sharing but intensified land use may require regulatory programs. Only the symptoms of eutrophication have been treated to date via weed harvesting and algae poisoning, but the state is committed to reduce phosphorus loadings from municipal and industrial wastes in Lake Michigan by 1972. Flood-plain management, fish control, and irrigation are other problem areas to be resolved. (Powers-Wisconsin)
W70-05103

WHY WATER POLUTION IS ECONOMICALLY UNAVOIDABLE,
Resources for the Future, Inc., Washington, D.C.
Allen V. Kneese.
Trans-Action, Vol 5, p 31-36, April 1968.

Descriptors: *Municipal wastes, *Water quality, *Water policy, *Economic justification, Economic feasibility, Industrial wastes, Environmental sanitation, Pollutants, Effluents, Water pollution control, Progressive taxes, Assessments, Laws, Benefit-cost theory.
Identifiers: Alkyl benzene sulfonate, Genossenschaften (German model).

The narrow consideration of physical effects (like dead fish) and objectives (every river pure) must be abandoned in favor of an analysis of public values before standards for water quality control can be established. Welfare economics--comparing damage done by wastes to cost of control, show that popular discontent is the major reason for stream pollution reduction, but to date public grievance has been only general and not specific. Industry discharges twice as much waste as municipalities, with amounts and control costs varying from plant to plant even within an industry, based on plant design and age. Thus a uniform effluent standard would impose higher per-unit costs on some plants while an effluent charge or tax, would allow individual adjustment. Pollution control may be most feasible where production processes are changed. Collective facilities may provide the best solution for waste treatment. German model shows that engineering to meet a region's needs is required; waste disposal is regionally managed, one stream reserved for waste disposal only, and major industries and cities in that region are charged according to the amount and quality of their waste outflow. (Powers-Wisconsin)
W70-05108

WATER CONSUMPTION STATISTICS IN THE TEXTILE INDUSTRY WITH SPECIAL REFERENCE TO THE FINISHING INDUSTRY,
H. Droszler.
VEB Zentrales Projektierungsburo der Textilindustrie, Leipsig, Germany Vol. 13, No. 7, p 371-376, 1963. 16 tab, 4 ref.

Descriptors: *Water requirements, Industrial wastes.
Identifiers: *Textile processes, Textile wastes, Fabric.

Because of the need for large quantities of pure water for the wet processing of textiles and the problems of disposal of this as industrial waste water, there is an increasing need for careful planning of operations. Tables and flow diagrams present detailed data on the amounts of water required per kilogram of fabric in these operations. Use of minimum amounts of water and its recirculation are emphasized. (Work - North Carolina State University)
W70-05130

WHERE DOES RESEARCH STAND IN WATER POLLUTION.
For primary bibliographic entry see Field 05D.
W70-05165

WATER POLLUTION CONTROL,
Paul D. Haney.
Water and Sewage Works, Vol. 106, p305-311, 1959.

Descriptors: *Water pollution control, *Water quality, Self-purification, Legislation, Dissolved oxygen.

Disposal of water-borne wastes in streams is natural, but it should be done in such a manner as not to destroy or unreasonably degrade the stream. Pollution control is the key to the reuse of water. A discussion of legislative acts over a 10-year period is included. Three graphs are used in a discussion of water-quality criteria. A 3-step approach to the problem of designing requirements for pollution control on a specific stream is given: (a) determination of water uses, (b) application of water-quality criteria in defining suitability of water, (c) formulation of waste-control regulations in accordance with engineering, economic, and equity relationships. Although developments have been made in industrial waste control (i.e., waste treatment and recovery of reusable wastes), no significant advances have been made in sewer treatment. (Robinson-North Carolina State Univ)
W70-05207

CHALLENGE TO RESEARCH BY WATER AND AIR POLLUTION PROBLEMS,
Allied Chemical Corp., New York.
R. W. Hess.
American Dyestuff Reporter, Vol. 45, p441-444, and 459, 1956.

Descriptors: *Water pollution control.
Identifiers: *Water pollution research, *Air pollution research, Water pollution index, Air pollution index, Analytical methods, Dyehouse wastes.

Before sound programs for air pollution control can be established more knowledge about the following is needed: (1) Factors which affect the natural cleaning processes of the atmosphere. (2) Effects of nature's radiant energies on reactions between contaminants with each other, and with atmospheric oxygen and water. (3) Relationships of inversions, turbulence, humidity, diffusion, eddies, temperature, and topography as aspects of meteorological conditions. Research is needed on water and atmospheric quality indices because the present indices are unreliable. Research is also needed on methods for waste control. Points for research attach on waste problems are threefold: (1) Development of production processes which will give the minimum amounts of objectionable wastes. (2) Recovery and utilization on more economical disposal than would be possible without recovery. (3) Research on methods for treating wastes since practical methods are either unknown or are very costly in most cases.
W70-05217

THE ECOLOGY OF A RESERVOIR,
For primary bibliographic entry see Field 05C.
W70-05264

WATER QUALITY MANAGEMENT SYMPOSIUM, PROCEEDINGS.
California Univ., Los Angeles. Water Resources Center.

Pillsbury, Arthur F., (ed.). Report no. 16, University of California, Los Angeles, Water Resources Center, Dec. 1969. 148 pp.

Descriptors: *Water quality control, *Future planning (Projected), Water (Demand), Political aspects, Legislation.
Identifiers: California.

This symposium is based on the theme of water quality management and its impact on man's future. Various articiles are included covering the following areas. Present technology and research needs; the quality of life in the environment of the future; matters before the California ligislature; the status of current ligislation on water quality management, and the policy issues in future water quality management. Appropriate portions of the publication are forwarded with abstracts of those portions. (See also W70-05277 thru W70-05279). (Grossman-Rutgers)
W70-05276

THE CONSTITUTIONALITY OF EFFLUENT CHARGES,
Wisconsin Univ., Madison. Water Resources Center.
S. R. Lyman.
Master of Laws Thesis, University of Wisconsin Law School. Available from the Clearinghouse as PB-190 667, $3.00 in paper copy, $0.65 in microfiche. The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 1-201, May 1969. 201 p, 40 ref.

Descriptors: *Effluents, *Pollution abatement, *Legislation, *Assessments, Water pollution control, Water utilization, Judicial decisions, Waste disposal, Public rights, Public benefits, Administrative agencies, Costs, Governments, Water quality control, Regulation, Taxes, Classification, Water policy, Reasonable use, Water costs, Damages, Impaired water quality, Control systems, Public health, Navigable waters.
Identifiers: *Effluent charges.

Effluent charges are monetary levies upon those who discharge waste into the waters of a state. These levies are determined by the quantity and quality of the waste discharged and computed on the basis of damage done to others by each unit of the discharge. Such a charge would be a valid regulation under the state's police power. Moreover, giving an administrative agency the power to administer an effluent-charge system would not be an unlawful delegation of legislative power. An effluent charge would be a regulatory fee under the police and not a tax. Even if considered a tax, it is an excise tax and would be constitutional. Effluent charges do not violate the Northwest Ordinance which prohibits imposing a tax for the use of navigable waters. The effect on downstream users of allowing the discharger to pollute at a price and the applicability of such a charge to municipal users are considered. State and federal effluent charges as navigational servitudes are also discussed. (See also W70-05321 thru W70-05331). (Caldwell-Florida)
W70-05320

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (EFFLUENT CHARGES--DEFINITION),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 1-21, May 1969. 21 p, 73 footnotes.

Descriptors: *Effluents, *Pollution abatement, *Water pollution control, *Water quality control, Costs, Impaired water quality, Classification, Water utilization, Water demand, Water conservation, Legislation, State governments, Federal government, Waste disposal, Resource allocation, Water pollution treatment, River basin development, Water policy, Public rights, Administration, Water resources, Assessment, Legal aspects.
Identifiers: *Effluent charges.

The continual production of excessive waste threatens to exhaust our available water supply, and the demand for usable water is constantly increasing. The effluent charge is an economic incentive technique for implementing water quality standards. It is a monetary levy imposed on anyone who contributes to water pollution by discharging waste and is computed on the basis of the quantity and quality of the waste so discharged. The basic principle is to require the producer of waste to pay all costs associated therewith. The effluent charge would yield substantial revenue, which could be used to finance administration and costs of water quality control in river basins. This charge is somewhat similar to sewer taxes and charges and highway-use taxes, although there are important differences which may affect constitutionality. There have never been any effluent charges in this country, although they have been used in Europe to good effect. However, there is a rising interest in effluent charges. The main question dealt with is whether such system would withstand constitutional challenge. Water classification is discussed. (See W70-05320). (Caldwell-Florida)
W70-05321

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--THE POLICE POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 22-52, May 1969. 30 p, 108 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Legislation, *Judicial decisions, Effluents, Water pollution control, Impaired water quality, Reasonable use, Riparian rights, Prior appropriation, Consumptive use, Water rights, Governments, Public benefits, Waste disposal, Control systems, Damages, Costs, Classification, Water utilization, Public health, Hydrology, Assessments, Legal aspects.
Identifiers: *Effluent charges.

A polluter against whom an effluent charge is levied could allege that such charge constituted a taking of private property without just compensation, and was thus unconstitutional. This claim would necessarily be based on alleged vested, private property rights. However, such rights may be regulated by the state under its police power as long as the regulation is calculated to further public health, safety, welfare, or morals, and bears a reasonable relation to the purpose of the regulation. Obviously, pollution control and abatement is a proper legislative purpose. The effluent charge bears a reasonable relation to this purpose in that it is directed toward the cause of pollution and is designed to reduce that cause. Courts generally accept the legislature's judgment on the 'reasonable relation' issue in the absence of extreme circumstances. The effluent charge system is not arbitrary in that it has a rational basis for its existence. Effluent charges are not discriminatory even though different polluters would be charged at different rates. The charge is based on the amount of damage done by each unit of waste discharged. Although this will vary with the different hydrologic characteristics of the water, it is not discriminatory. (See W70-05320). (Caldwell-Florida)
W70-05322

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--EMINENT DOMAIN),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 53-59, May 1969. 7 p, 35 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Waste disposal, *Water pollution control, Judicial decisions, Effluents, Impaired water quality, Reasonable use, Riparian rights, Consumptive use, Water rights, Governments, Legislation, Control systems, Damages, Costs, Water utilization, Water costs, Public health, Assessments, Legal aspects.
Identifiers: *Effluent charges.

Another argument that might be raised against effluent charges by polluters is that the effluent charge system is a 'taking' of rights, thus falling under the state's power of eminent domain and requiring the payment of just compensation. However, courts have generally held that regulations may cause economic losses to a member of the regulated class, or even prohibit a certain use of property altogether and still not constitute a taking for which compensation must be paid. The regulation may still be valid under the police power. Water pollution control measures have usually been considered police power regulations. Further, any 'right to pollute' which may exist is not separate property but merely a 'use' which may be prohibitied without the payment of compensation. This restraint on the use of water would not amount to a substantial deprivation of all the uses of water, and any harm therefrom would be outweighed by the collective benefit. (See W70-05320). (Caldwell-Florida)
W70-05323

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER-UNLAWFUL DELEGATION),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 60-73, May 1969. 14 p, 51 footnotes.

Descriptors: *Pollution abatement, *Regulation, *Administrative agencies, *Legislation, Water pollution control, Water quality control, Control systems, Water rights, Governments, State governments, Judicial decisions, Administration, Public benefits, Waste disposal, Costs, Classification, Water utilization, Water rights, Impaired water quality, Assessments, Legal aspects.
Identifiers: *Effluent charges.

A waste discharger may argue that placing administrative responsibility for an effluent-charge system

into the hands of a public agency amounts to an unlawful delegation of legislative and judicial power. The agency would be empowered to set rates to be charged upon each unit of waste, which would vary according to many factors, and to assess and collect each polluter's assessed charge. In all states, administrative agencies with varying powers and duties, handle water pollution control and abatement regulation. Generally, courts have held that, if sufficiently clear guidelines for agency action are laid down, legislatures may delegate the reasonable authority necessary to accomplish desired constitutional purposes. A setting forth in reasonably specific terms of agency powers and responsibilities should avoid any question, on these grounds, as to the constitutionality of effluent charges. (See W70-05320). (Caldwell-Florida)
W70-05324

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE WASTE DISCHARGER--THE TAX POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 74-99, May 1969. 26 p, 117 footnotes.

Descriptors: *Taxes, *Regulation, *Pollution abatement, *Assessment, Tax rate, Costs, Governments, Legislation, Effluents, Administrative costs, Water pollution control, Judicial decisions, Waste disposal, State governments, Federal government, Water quality control, Damages, Public benefits, Control systems, Costs, Classification, Legal aspects.
Identifiers: *Effluent charges, *Fees.

Waste dischargers may contend that effluent charges constitute an unconstitutional tax. However, it can be argued that effluent-charge systems are regulatory measures, with charges being fees rather than taxes. If the purpose of an enactment is for regulation rather than revenue, the measure falls under the police power. Fees collected under an effluent-charge system should be reasonably related to the costs of administering the program and abating the pollution. As long as it is reasonable the size of the fee would not detract from its validity as a police-power measure, nor cause it to become a tax. The purpose of the effluent charge is primarily regulatory. It is designed to control and abate pollution of a state's waters and to benefit the health, safety, and welfare of the people of the state. It is clearly an exercise of the police power. As such, the measure need not comply with state constitutional provisions requiring equality and uniformity, and it does not offend the equal protection clause of the federal constitution. Even if the effluent charge is considered a tax, it is a privilege or an excise tax on the use of the water and is constitutional. (See W70-05320). (Caldwell-Florida)
W70-05325

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE NORTHWEST ORDINANCE--THE TAX POWER),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 100-123, May 1969. 24 p, 141 footnotes.

Descriptors: *Effluents, *Water quality control, *Regulation, *Water pollution control, Industrial wastes, Waste water (Pollution), Rivers, St. Lawrence River, Mississippi River, Legislation, Water pollution, Transportation, Navigable waters, Water quality, Structures, Rates, Taxes, Non-structural alternatives, Tariff, Public health, Federal government, State governments, Legal aspects, Navigation, Pollution abatement.
Identifiers: *Effluent charges.

The two major alternatives to considering an effluent charge as something other than an exercise of the police power are: (1) to consider the charge a toll compensating for the use of improvements on a navigable waterway; or (2) to consider the charge a valid excise tax upon the privilege of depositing waste into the waters. Waste dischargers might argue that such a charge is violative of the Northwest Ordinance and the Commerce Clause of the Constitution, both of which prohibit the imposition of a tax on the use of navigable waters. The Supreme Court of the United States has said that navigable waters are highways of commerce open to all and free from tax for their navigation. The one exception to this rule is the exaction of tolls by the states for the use of improvements on navigable waters. This is not a tax but is compensation for use. This exception can be extended by analogy to the effluent charge. Also, if viewed as an excise tax, effluent charges would not be violative of the Northwest Ordinance provision against taxation of navigation. Such tax would be levied not upon navigation, but upon the privilege of depositing wastes into state waters. (See W70-05320). (Barnett-Florida)
W70-05326

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE DOWNSTREAM USERS),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 124-135, May 1969. 12 p, 48 footnotes.

Descriptors: *Wisconsin, *Water pollution control, *Riparian rights, *Effluents, Judicial decisions, Administrative agencies, Water quality control, Industrial wastes, Discharge (Water), Waste water (Pollution), Rivers, Legislation, Water pollution, Legal aspects, Prior appropriation, Competing uses, Abatement, Water quality, Rates, Regulation, Public health, Federal government, State governments, Economics.
Identifiers: *Effluent charges.

Downstream water users might object to an effluent charge system on the basis that it abrogates their common-law right of action against the upstream waste-discharger. The establishment of the effluent charge system does not necessarily result in such denial of due process to downstream water users. Although the payment of the charge allows the discharge of wastes into the state's waters, any unreasonable discharge would still be subject to an action for an injunction or damages by the downstream users. For example, courts have held that, although the polluter has been sanctioned by a state agency, the particular sanction might be beyond the reasonable exercise of the state police power. This preserves a right of action to the downstream users and compensation for their loss. However, such damage payment by the discharger plus the prior payment of an effluent charge to the state seems unduly harsh. To avoid this and to preserve the common-law right of action, provisions should be made for offsetting the effluent charge by the amount of damages paid to the downstream user. Thus, the effluent charge system would accomplish its purpose of water quality control and maintain the constitutional rights of due process for all parties concerned. (See W70-05320). (Barnett-Florida)
W70-05327

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE MUNICIPAL USERS),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 136-139, May 1969. 4 p, 15 footnotes.

Descriptors: *Wisconsin, *Cities, *Municipal wastes, *Effluents, Water quality control, Liquid wastes, Discharge (Water), Waste water (Pollution), Rivers, Legislation, Water pollution abatement, Water quality, Rates, Regulation, Federal government, State governments, Public health, Water pollution control, Sewage effluents, Sewage disposal, Legal aspects, Administration, Local governments.
Identifiers: *Effluent charges.

Municipal corporations are some of the largest polluters in the nation. Thus they are most likely to challenge the effluent charge system as a denial of due process and equal protection. Courts have noted that municipalities are creatures of the state and as such have no protection against regulation by the legislature. A municipal corporation has no privileges or immunities under the federal constitution which it may invoke against state legislation affecting it. Also, a municipal tax payer has no right of action of the municipality with which he identifies has none. If an effluent charge is enacted by the state legislature, and imposed upon a municipal corporation, neither the corporation nor a municipal taxpayer will have standing to challenge the constitutionality of the effluent charge. (See W70-05320). (Barnett-Florida)
W70-05328

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (FEDERAL EFFLUENT CHARGE--NAVIGATIONAL SERVITUDE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 140-156, May 1969. 17 p, 88 footnotes.

Descriptors: *Water quality control, *Water pollution control, *Federal government, *Effluents, Wisconsin, Industrial wastes, Waste water (Pollution), Navigable waters, Navigable rivers, Ownership of bed, Riparian rights, Riparian waters, Prior appropriation, Reasonable use, Surface waters, Obstruction to flow, Streamflow, Banks, Legal aspects, Riparian land, Regulation, Public health, Legislation.
Identifiers: *Effluent charges.

A federally created effluent charge may be justified by Congress as a valid exercise of its power under the Commerce Clause of the Constitution. From the time of John Marshall, the federal government has had control over interstate commerce and the navigable waters of our nation. Such control should extend to the authorization of effluent charges, since they are designed in part to benefit, improve, and protect navigation. Any alleged 'taking' by the imposition of effluent charges, such as the taking of the right to pollute reasonably, the taking of the special value of the waste discharger's property, or the taking of the downstream user's right to receive the water undiminished by pollution, does not give rise to a constitutional duty to pay compensation. The effluent charge is considered enacted in furtherance of navigation upon the nation's waterways and is thus an exercise of its navigational servitude. The property taken by effluent charges is subject to this servitude and therefore no compensation is necessary. (See W70-05320). (Barnett-Florida)
W70-05329

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (STATE EFFLUENT CHARGE--NAVIGATIONAL SERVITUDE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 157-169, May 1969. 13 p, 58 footnotes.

Descriptors: *State governments, *Water quality control, *Effluents, Wisconsin, Industrial wastes, Waste water (Pollution), Navigable waters, Navigable rivers, Riparian rights, Riparian waters, Riparian land, Ownership of beds, Prior appropriation, Reasonable use, Surface waters, Obstruction to flow, Banks, Legal aspects, Regulation, Public health, Eminent domain, Water pollution control, Legislation, Compensation.
Identifiers: *Effluent charges.

Waste dischargers might contend that effluent charges upon the disposal of wastes into navigable water bodies deprive them of property without compensation. However, such charge should not be considered violative of the dischargers' rights where the enactment is declared to be, and is, in aid

of navigation. The state may rely upon this concept of a state navigational servitude instead of, or in addition to, their reliance upon the state's police power and power to tax. Some courts have held that states, as trustees for the benefit of the people, have power to deal with navigable waters of the state in any manner consistent with the improvement of navigation, and that where so dealing with these waters, damaged private rights are not compensable. (See W70-05320). (Barnett-Florida)
W70-05330

THE CONSTITUTIONALITY OF EFFLUENT CHARGES (THE GENERAL PUBLIC--THE TRUST DOCTRINE),
S. R. Lyman.
The Constitutionality of Effluent Charges, Univ of Wis Water Resources Center, p 170-189, May 1969. 20 p, 82 footnotes.

Descriptors: *Navigable waters, *Effluents, *Water pollution control, *Legislation, Riparian rights, State governments, Wisconsin, Ownership of beds, Water quality control, Navigable rivers, Compensation, Permits, Regulation, Legal aspects, Prior appropriation, Riparian waters, Riparian land, Reasonable use, Surface waters, Obstruction to flow, Public health.
Identifiers: *Effluent charges.

The general public has an interest in the navigable waters of the state that is superior to any right of any individual. Thus, the state, acting for the general public, should be able to establish an effluent charge system without compensating for private rights affected thereby. Such regulations are an exercise of the 'trust doctrine' which declares that the navigable waters of the state are held in trust by the state for the benefit of the public. Regulation by the state for the public's benefit does not deprive the riparian owner of any right. It merely limits the exercise of existing rights. Thus, no compensation need be paid. Some opponents of effluent charges might contend that such charges operate to license pollution of waters in violation of the public trust. Arguments considering both sides are presented. A summary conclusion and a sample proposal for enacting effluent-charge legislation is included herein. (See W70-05320). (Barnett-Florida)
W70-05331

LEGAL CONTROL OF WATER POLLUTION.

University of California, Davis, Law Review, p 1-263, 1969. 263 p.

Descriptors: *Water pollution control, *Pollution abatement, *Governments, *Long-term planning, Legal aspects, Water pollution, Water pollution treatment, Industrial wastes, Treatment facilities, Costs, Federal government, State governments, Interstate compacts, Programs, Groundwater pollution, Oceans, Impaired water quality, Regulation, Administrative agencies, Water quality control, Regions, River basin commissions, Legislation, Water utilization, Encroachment.
Identifiers: Federal Water Pollution Control Act.

An overview of the problem of water pollution control in the United States is presented, with various articles dealing with specific areas of concern. The California system of water pollution control is analyzed, showing how states can deal with the problem occurring in intrastate watersheds. Interstate compacts as a means of controlling pollution in interstate river basins are examined, emphasizing the need for regional river basin commissions with sufficient interstate authority to deal with the problem. Federal water pollution control programs are examined in detail, and a greater federal role is proposed. An inquiry into means by which the private sector of the economy can take a more prominent place in pollution control efforts is presented. The sources and effect of pollution of groundwater are examined, and the special problems of groundwater pollution control are outlined. The problem of pollution of the oceans is discussed, with sources and effects of the various types of pollution explained and solutions proposed. The effect of saline encroachment in the San Joaquin Delta is examined, and the possible effect of negotiated concerted action by concerned groups is analyzed. (See also W70-05343 thru W70-05349). (Caldwell-Florida)
W70-05342

STATE CONTROL OF WATER POLLUTION: THE CALIFORNIA MODEL.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 1-41, 1969, 41 p.

Descriptors: *Water pollution control, *State governments, *Pollution abatement, *Regulation, Industrial wastes, Agricultural chemicals, Water pollution sources, Water pollution, Waste disposal, Impaired water quality, Water utilization, Thermal pollution, Groundwater, Groundwater basins, Encroachment, Reasonable use, Legislation, Riparian rights, Treatment facilities, Costs, Water quality control, Water policy, Planning.

California's five main pollution problems are: agricultural pollution, industry, sewage, salt water encroachment and atomic waste. Prior to 1949, the State Department of Public Health had primary pollution control responsibility, and proceeded on a permit system with rigid criteria for construction of treatment facilities. The current California law, passed in 1949, provides that the Health Department has responsibility for all public health hazards, while state and regional water quality control boards have responsibility for all economic damage to the state. These boards formulate state and regional water policies, set waste discharge requirements and aid individuals in pollution problems. The State Department of Fish and Game maintains an extensive water quality program oriented toward wildlife protection. The common law riparian rights concept is part of California law. The reasonable use and natural use doctrines are recognized, and actions for trespass and nuisance are also available. Damages and injunctions are remedies. The current statutory program has been largely effective. However, it should be re-examined with an eye toward increasing its effectiveness under present conditions. (See W70-05342). (Caldwell-Florida)
W70-05343

WATER POLLUTION CONTROL THROUGH INTERSTATE AGREEMENT.
In U Cal Davis L Rev, Legal Control of Water Pollution, p 43-70, 1969, 27 p.

Descriptors: *Water pollution control, *Interstate compacts, *River basin commissions, *Regions, Coordination, Interstate rivers, Legislation, Administrative agencies, Delaware River Basin Commission, Pollution abatement, Regulation, Treatment facilities, Water Quality Act, Water quality control, Water utilization, River basins, Costs, State governments, Federal government, New England Interstate WPS Compact, Industrial wastes, Impaired water quality, Legal aspects.

When economically significant rivers flow through more than one state, control of water pollution requires interstate cooperation. Interstate compacts, setting up river basin commissions whose responsibility for pollution control extends over the entire basin, are the most logical means for combatting pollution. Several such interstate agencies are now in existence, of which the Delaware River Basin Commission is the most effective. The Lake Champlain Basin Compact, the Tri-state Compact, the Ohio River Valley Compact, the Tennessee, Arkansas, Ohio, Potomac, and Columbia River Basins Compacts, and the Great Lakes Basin Compacts are other agreements now in existence. All agreements except the Delaware Compact suffer from two or more of the following deficiencies: (1) failure to grant the agency concerned authority to deal with water pollution as an integral part of other water resource problems; (2) failure of the agencies to set adequate standards or to enforce the minimal standards set; (3) lack of authority in some agencies to enforce any standard. The above-listed agencies have been largely ineffective in coping with the problem. However, growing national concern, the increasing role played by the federal government, and the effect of the quite successful Delaware River Basin Commission may point the way toward more effective efforts in the future. (See W70-05342). (Caldwell-Florida)
W70-05344

FEDERAL PROGRAMS FOR WATER POLLUTION CONTROL.
In U Cal Davis L Rev, Legal Control of Water Pollution, p 71-104, 1969.

Descriptors: *Water pollution control, *Federal government, *Legislation, *Programs, State governments, Local governments, Regulation, Interstate compacts, Planning, River basins, Administrative agencies, Political aspects, Legal aspects, Pollution abatement, Costs, Treatment facilities, Standards, Water quality control, Grants, Federal jurisdiction, Shellfish, International waters, Conferences, Coordination.
Identifiers. Federal Water Pollution Control Act.

The federal government is committed to a leading role in the effort to control water pollution. Federal programs heretofore have attempted to stimulate state and local efforts, rather than providing direct federal initiatives addressed to the problem. The ineffectiveness of state and local controls, interstate compacts, and private lawsuits suggest that more direct federal action is necessary, as federal efforts are likely to be more effective politically and legally. The current federal program includes the Federal Water Pollution Control Act, which provides financial and technical assistance to state and local authorities in the form of construction, program, research, and comprehensive basin planning grants. Direct federal operations in the areas of planning, research, training, and technical assistance in specific problem areas are authorized. The Act provides for federal sanctions for pollution of interstate or navigable waterways. Abatement proceedings are set up in the Act, the major steps being conferences, then hearings, then, if necessary, court action. The Act sets up water quality standards for interstate waters, and requires states to set their own standards. The Rivers and Harbors Act of 1899 and the Oil Pollution Act of 1924 are other pieces of Federal legislation in this area. It is concluded that the limitation of the federal government to a supporting role in combatting water pollution has curtailed its effectiveness. (See W70-05342). (Caldwell-Florida)
W70-05345

SPECIAL PROBLEMS OF WATER POLLUTION: THE PRIVATE SECTOR.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 105-139, 1969, 34 p.

Descriptors: *Water pollution control, *Water pollution sources, *Industrial wastes, *Remedies, Agricultural chemicals, Water pollution effects, Pollutant identification, Biochemical oxygen demand, Pulp wastes, Effluents, Water pollution treatment, Costs, Thermal pollution, Chemical wastes, Acid mine water, Sludge, Pesticides, Animal wastes, Saline waters, Treatment facilities, Economics, Legislation, Regulation, Water utilization, Legal aspects.
Identifiers: Effluent charges, Incentive programs.

The dramatic increase in water needs makes it imperative that water pollution be controlled. The effects of pollutants on water are varied, but all have the result of making the water unusable. Sources of industrial pollution include pulp wastes, chemical industry wastes, thermal pollution, iron and byproducts from steel mills, acid mine water, food

processing industry wastes, and petroleum wastes. Almost all industries are attempting to control pollution by methods such as lagooning, chemical purification, cooling towers, and filtration, but pollution control measures are uniformly expensive. Agricultural pollution gets into water courses by runoff or seepage, or by direct aerial application. Pesticides, animal wastes, and irrigation pollution (concentration of salts and minerals in irrigated land) are major sources of agricultural pollution. In many areas technology is adequate to deal with pollution, and only funds are needed. In other areas, research is still needed. From the economics standpoint, pollution causes an inefficient allocation of many resources. Several forms of controls may be used: (1) the common law private remedy approach; (2) government regulation and enforcement; (3) payments and incentives; and (4) effluent charges. The latter form, making the polluter rather than society pay the cost of pollution, may have the best chance of success. (See W70-05342). (Caldwell-Florida)
W70-05346

POLLUTION OF GROUNDWATER.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 141-165, 1969. 24 p.

Descriptors: *Groundwater, *Surface-groundwater relationships, *Waste disposal, *Water pollution control, Saline water intrusion, Water demand, Groundwater basins, Water pollution sources, Waste storage, Cesspools, Sewage effluents, Landfills, Seepage, Groundwater movement, Groundwater recharge, Acquifers, Base flow, Water purification, Withdrawal, Legal aspects, Prior appropriation, Standards, Legislation.
Identifiers: *Groundwater pollution.

Groundwater pollution presents a unique set of problems. The travel of such pollution and the archaic legal doctrines which govern groundwater complicate the situation. Waste disposal and salinity are the two major sources of groundwater pollution. Major waste disposal methods resulting in groundwater contamination include: (1) impoundments and lagoons; (2) septic tanks and cesspools; (3) landfills; (4) surface water waste disposal; and (5) disposal wells. Salinity in groundwater may come from sea water intrusion resulting from excessive withdrawals from coastal acquifers, or from irrigation, which eventually leaches out salts in the soil and carries them down to groundwater acquifers. The movement of polluted groundwater makes it difficult to trace the pollutant to its source and to set meaningful waste disposal standards. Natural groundwater purification processes (filtration, absorption, degradation, and dilution) should not be relied on for protection from contamination. Archaic legal doctrines, flowing from the absolute dominion rule, hamper the effectiveness of control programs. Intensive research on pollution travel is needed, and the knowledge applied to setting disposal standards. A re-evaluation of current water-rights doctrine is necessary, and workable means of controlling withdrawal from acquifers to prevent saline intrusions must be developed. (See W70-05342). (Caldwell-Florida)
W70-05347

POLLUTION OF THE SEA.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 167-204, 1969, 37 p.

Descriptors: *Water pollution control, *Oceans, *International law, *Water pollution sources, Water utilization, Regulation, Legal aspects, Pollutant identification, Legislation, Water pollution effects, Marine animals, Water conservation, Damages, Oil, Pollution abatement, Water pollution treatment, Judicial decisions, Nuclear wastes, Radioactive waste disposal, Sampling, Municipal wastes, Thermal pollution, Standards, River and Harbors Act.
Identifiers: *Oil pollution, *Nuclear pollution, Penalties (Civil).

The need for ocean pollution control on both a unilateral and an international basis is acute since the sea is becoming increasingly important as a food and mineral resource. A definition of marine pollution to be effective should encompass all sources of pollution but limit itself to alterations of the water which produce harm to its use. Oil pollution is dramatically increasing, and both national and international regulation is necessary to resolve the problem. The Oil Pollution Act of 1924 and the Rivers and Harbors Act of 1899 are of limited effectiveness. Several international conventions treating the problem exist, but are ineffective. The total prohibition of oil discharges anywhere at sea is necessary, together with strong international sanctions. Nuclear pollution is potentially dangerous. The strict unilateral controls of the United States and Great Britain could serve as examples for international action. International agreement on nuclear pollution control has been hampered by the Cold War. Municipal wastes, including sewage and thermal pollution, present a serious problem. Strong unilateral controls are essential, and international agreements are necessary to coordinate these efforts and to insure that all nations have effective pollution control programs. (See W70-05342). (Caldwell-Florida)
W70-05348

SAN JOAQUIN DELTA: IS NEGOTIATION A SOLUTION.

In U Cal Davis L Rev, Legal Control of Water Pollution, p 209-263, 1969, 54 p.

Descriptors: *Water pollution control, *Salt water intrusion, *Water users, *Negotiations, Water distribution (Applied), Consumptive use, Withdrawal, Agricultural chemicals, Irrigation practices, Economics, Land use, Legislation, Judicial decisions, Acquifer characteristics, Inflow, Water quality control, Water utilization, Impaired water quality, Water pollution effects, Barriers, Water demand, Administrative agencies, Diversion losses, Diversion structures, California.

The San Joaquin Delta is a rich farming area between San Francisco and Sacramento whose watershed covers one-third of California. For many years, saline water intrusion has been the major pollution threat. Export agencies (federal and state) whose projects transport water around the Delta are the largest water consumers. Agricultural, municipal, and industrial consumers also deplete the water supply. Conflict results from these groups' divisive interests. Water quality degradation affects all users, especially the export agencies and agricultural users. Release of waters from upstream dams has in recent years provided a 'stop-gap' means of control, but other means of increasing the water supply are being proposed. Negotiation among competing users has been a fairly effective means of arriving at solutions to the problem, but is questioned whether this process can obtain optimal allocation of water resources. The extreme diversity of interests and the question of whether negotiated solutions will fulfill public needs are causes for pessimism. A set of acceptible water criteria is a probable result of negotiation. Watershed and county protection statutes, the development of a statewide water plan and recognition by the courts of the complex nature of the problem may have a beneficial effect on attempts to control the pollution. (See W70-05342). (Caldwell-Florida)
W70-05349

JOINT USE OF MUNICIPAL SEWERS.
Iowa Code Ann secs 392.1-392.3 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Sewers, *Drainage systems, *Cities, Legislation, Disposal, Pipes, Sewage disposal, Sewage districts, Rates, Assessments, Local governments, Streams, Rivers, Administration, Administrative agencies, Waste water treatment, Municipal wastes, Water supply, Joint costs, Construction costs, Costs, Financing.

When the boundaries of cities or towns join and such cities are located adjacent to a river or stream which furnishes drainage or the source of water supply for such cities, the cities may contract with each other for the joint use of the sanitary sewer system of either of the cities. A consideration mutually agreed upon shall be paid for the use of such sanitary sewer system by the dominant city to the servient one. The city which is to use the other's sanitary sewer system shall have authority to lay all necessary lines connecting the two sewer systems. The city building such lines shall levy special assessments against any property benefited by the sanitary sewer system. Sewer districts may be established with annual levies imposed on property therein to meet the project costs. Such assessments are to be levied in proportion to the benefits received. (Barnett-Florida)
W70-05352

MINING AND SMELTING (DRAINAGE OF MINE WATER).
Wis Stat Ann secs 107.05, 107.06 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Mining, *Water conveyance, *Mine drainage, Permits, Legislation, Iron, Hydraulic mining water, Mine wastes, Controlled drainage, Diversion, Diversion structures, Surface waters, Riparian rights, Consumptive use, Administrative agencies, Public benefits, Public rights, Groundwater, Condemnation, Eminent domain, Legal aspects.
Identifiers: Inverse condemnation.

Every person engaged in mining has the right to convey water away from his mines, either over or below the surface of any adjoining land. If surface streams or lakes are involved, a permit to convey water to the same or another watershed must be obtained from the Department of Resource Development. Provisions are made for notice, hearing, and protection of the rights of downstream riparians. If the miner owns riparian land or land with underground water, he may include a request for a permit to divert and use such water in his mining operations. Permits shall be granted where the public benefits from the mining operation outweigh its impairment of public rights in the stream. Conditions may be attached to the permit and security required to protect the public interest. Where no agreement can be reached with the adjoining land owner as to payment for damages caused by conveyance of water over his land, the person engaged in mining may move to acquire the right to convey. (Cuevas-Florida)
W70-05355

WATER POLLUTION CONTROL AND PUBLIC WATER SUPPLY.

Ohio Rev Code Ann secs 6111.12 thru 6111.30, 6111.99 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water supply, *Administration, *Water control, Legal aspects, Legislation, Water resources development, Water works, Municipal water, Water pollution, Water pollution control, Public health, Water purification, Taxes, Water storage, Water treatment, Water quality control, Water distribution, Bodies of water, Fluoridation, Administrative agencies, Supervisory control (Power).

The Department of Health exercises general supervisory control over the state's public water supply and water works systems, including all features of construction, operation, inspection, and maintenance of systems for supply, treatment, storage, and distribution, which do or may affect the sanitary quality or flouride content of the water supply. The Director of Health must investigate all complaints of impure water or inadequate flouridation. Procedures for the addition of flouride to public water supply systems are set forth. Periodic analysis of public water must be made by the Department. Unauthorized connections into a public water supply system are prohibited. Procedures for ap-

peal from orders of the Director of Health are established. Tax exemptions for water pollution control facilities are provided. The Water Pollution Control Board may investigate pollution of any state waters and is authorized to enter on public and private property to inspect and investigate conditions of pollution. (Casey-Florida)
W70-05356

METROPOLITAN SEWERAGE DISTRICTS.
Wis Stat Ann secs 66.20-66.208 (1965), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Sewage districts, *Sewage, Legal aspects, Legislation, Sewage treatment, Sewers, Navigable waters, construction, Condemnation, Eminent domain, Costs, Cities, Municipal wastes, Domestic wastes, Industrial wastes, Administration, State governments, Public health, Tax rate, Assessments, Riparian rights.

The county courts may establish metropolitan sewerage districts upon petition by the prescribed number of electors. Real property owners and municipal governments may object to establishment of districts; procedures for hearing and appeal are set forth. The district may detach lands not required by the interests of public health and welfare. Districts may issue bonds for the construction and improvement of sewage systems and may levy direct taxes to pay the principal and interest on such bonds. The district commissioners are authorized to plan, construct, maintain, and operate sewage systems. Districts may cross any navigable state waterway, acquire any property in the district necessary to accomplish its purposes, and make special assessments against property which is served by the districts' sewage system. (Casey-Florida)
W70-05362

FRITZ V BD OF TRUSTEES (ASSESSMENTS FOR CONSTRUCTION OF A SANITARY SEWER SYSTEM).
252 NE2d 567-572 (Ind 1969).

Descriptors: *Indiana, *Sewage disposal, *Local governments, *Cost allocation, Construction costs, Costs, Cost sharing, Government finance, Taxes, Sewage, Judicial decisions, Legal aspects, Financing.
Identifiers: *Sewer systems, Injunctions (Prohibitory).

Trustees of appellee town resolved to install within the town a sanitary sewer system. The resolution provided for assessment of all property within the town to pay for construction of the system. Provision was made for a public hearing to finalize the resolution and allow remonstrances in opposition to the plan. Notice of the hearing was posted in five locations. No remonstrances were filed and the trustees confirmed the resolution and assessed appellant's property. Appellants brought action to enjoin the enforcement of the assessment. The trial court upheld the trustees actions. The supreme court, in reversing, held that appellants were deprived of due process of law by the failure of appellees to give adequate notice of the sewer assessment proceedings. It was uncontradicted that appellants received no actual notice of the hearings. A property owner should not be forced to continually search public records for notice of proceedings affecting his property. When assessment proceedings affect specific property, notice should be given in a manner calculated to provide actual notice to affected individuals. (Dye-Florida)
W70-05366

NATURAL LAKES AND PONDS (POLLUTION OF WATER SUPPLY).

Pa Stat Ann tit 35, secs 731, 732 (1964).

Descriptors: *Pennsylvania, *Lakes, *Ponds, *Wastes, Buildings, Domestic wastes, Water pollution sources, Domestic water, Pollution abatement, Water pollution, Legislation, Legal aspects, Water quality, Impaired water quality, Potable water, Public health, Water quality control, Environmental sanitation, Remedies.
Identifiers: Injunctions (Prohibitory), Penalties (Civil).

It is unlawful to occupy living quarters or permit another to occupy living quarters in a building over a natural lake or pond which is the source of water used for human consumption. Depositing of foreign substances in such waters is also prohibited. Penalties are prescribed. The court of common pleas may enjoin violations of this statute upon application of the Department of Health or any person particularly aggrieved. (Cuevas-Florida)
W70-05369

THE POTENTIAL ROLE OF FISHERY MANAGEMENT IN THE REDUCTION OF CHAOBORID MIDGE POPULATIONS AND WATER QUALITY ENHANCEMENT,
S. F. Cook, Jr.
California Vector Views, Vol 15, No 7, p 63-70, July 1968. 2 fig, 11 ref.

Descriptors: Fish management, Stream improvement, *Water quality control, *Midges, Fish food organisms, Nutrients, Energy transfer, *Food chains, Food webs, Forage fish, Plankton, Algae, *Algal control, Predation, Competition, *Insect control.
Identifiers: *Fishery management, *Chaoborid midges, Clear Lake (Calif), Nutrient energy pathways, Trophic relationships.

Information has been acquired indicating that at least partial biological control of chaoborid midges and planktonic algae may be possible with the use of fish. Two basic concepts pertaining to this relationship have been explored; control through direct influence of predation and control through competition for nutrient energy. The emphasis is placed on the latter concept, and means for its implementation are discussed. The work has centered primarily upon the trophic relationships between the midges and plankton and two species of atherinid silversides and the threadfin shad. (Sjolseth-Washington)
W70-05428

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
William A. Rosenkranz.
Available from the Clearinghouse as PB-190 799, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-36, January 1970. 121 p, 3 fig, 1 tab, 24 ref. FWPCA Project 11000---12/69.

Descriptors: *Sewers, *Urbanization, *Storm drains, Sewage treatment, Sewage disposal, Cities, Research and development, Grants, Federal Government, Water pollution control.
Identifiers: Combined sewers.

Studies sponsored by FWPCA of combined storm and sanitary sewers and treatment of combined wastes are listed, abstracts of completed reports are presented, and active projects are described in information sheets. Subjects needing more research are also listed and described. Equipment, data methods, and criteria for urban drainage projects are outlined. (Knapp-USGS)
W70-05467

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
Ronald E. Nece.
Available from the Clearinghouse as PB-190 800, $3.00 in paper copy, $0.65 in microfiche. Washington University Department of Civil Engineering Hydraulics Lab Technical Report No 26, June 1969. 97 p, 58 fig, 21 ref. FWPCA Project 16080---9/69, Grant WP-00512-5.

Descriptors: *Waste dilution, *Mixing, *Sewage disposal, *Outlets, *Intakes, Sewers, Orifices, Discharge lines, Hydraulics.
Identifiers: Suction manifolds.

Experimental data were obtained on the external hydraulic characteristics and mixing characteristics of suction manifolds to be used in feasibility and design studies of using such devices for predilution in sewer outfalls. Dilution rates and head loss characteristics are given for six single circular side-port manifolds, for multiport manifolds incorporating the same side ports, and for annular ports with and without axial symmetry. Density differentials have relatively little effect on the dilution-head loss characteristics of the configurations tested. Comparison of the two geometries tested shows that the annular-port manifold possesses hydraulic advantages over single circular side-port manifolds. Limitations of operating ranges of the manifolds in sewer outfall applications are delineated. (Knapp-USGS)
W70-05468

PERSPECTIVE ON THE REGULATION OF UNDERGROUND INJECTION OF WASTEWATERS,
Ohio River Valley Water Sanitation Commission, Cincinnati; and Federal Water Pollution Control Administration.
Edward J. Cleary, and Don L. Warner.
Cincinnati, Ohio River Valley Water Sanitation Commission, December 1969. 88 p, 14 fig, 6 tab, 36 ref, 2 append.

Descriptors: *Waste disposal, *Injection wells, *Hydrogeology, *Water law, *Reviews, Regulation, Legislation, Legal aspects, Water pollution control, Groundwater, Aquifers, Ohio River, Sanitary engineering, Environmental engineering, Surveys, Investigations, Political aspects, Administration.
Identifiers: Ohio River Valley, Waste disposal wells, Disposal wells.

The eight states of the Ohio River Valley Water Sanitation Commission (ORSANCO) commissioned a study of policies, procedures and other matters allied to the practice of subsurface disposal. Perspective and guidelines are offered in a monograph on the regulation of underground injection of wastewaters. The first section provides background on public policy issues associated with environmental factors and subsurface-resources, including legislative and legal aspects. Part II discusses administrative procedures, geological evaluation and technical criteria relating to injection-well practice, specifically in the Ohio Valley. There is growing concern that wastewater injection may be proceeding faster than warranted by knowledge and regulatory procedures. A deep-well disposal system near Denver may have triggered earth tremors in the area. Legal concern exists with respect to underground trespass. No state prohibits underground disposal, but nine states subscribe to a policy of either rejecting applications or discouraging them. Only Ohio, West Virginia and Texas have specific legislation pertaining to the regulation of industrial wastewater injection. There is no specific federal legislation on deep-well disposal. Only small areas of the Ohio Valley would appear to be eliminated or significantly limited for waste injection on the basis of the most general consideration of the rock units that are present, their geologic structure, and the groundwater circumstances. For abandonment of an injection system, it is suggested that wells be completely plugged with cement and that a permanent monument be constructed at the well site. (Knapp-USGS)
W70-05521

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

REVERSE OSMOSIS TUBULAR MODULE OPTIMIZATION,
Philco-Ford Corp., Newport Beach, Calif.
For primary bibliographic entry see Field 03A.
W70-05080

RUNOFF FORECASTS BY LINEAR PREDICTIVE FILTER,
Tokyo Inst. of Tech. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-05139

POPULATION MODELS AND TEST POPULATIONS AS RESEARCH TOOLS,
Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.
For primary bibliographic entry see Field 07B.
W70-05414

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
Donald G. Watts, and Orie L. Loucks.
Institute for Environmental Studies, University of Wisconsin, Madison, February 4, 1969. 18 p. 8 fig, 8 ref.

Descriptors: *Systems analysis, *Ecosystems, Computer models, Simulation analysis, Model studies.
Identifiers: *Transfer function models, Nutrient transport models, International Biological Program, Ecosystem model, Lake Wingra (Wis).

Recently, attention has been focused on the application of systems analysis to description and modeling of large-scale man-environment-biota interdependency. Through sponsorship of the International Biological Program, systems analysis based transfer function models have been developed for predicting exchanges of materials into, within, and out of the Lake Wingra, Wisconsin, drainage basin. Previous 'compartment' models inclined to be too general in identification of transfer mecahnisms for materials such as nutrients, thus causing inconsistencies between aquatic and terrestrial models. The proposed transfer function models are of fundamental importance to developing ecosystem models with simulation and prediction capabilities. They provide an extremely detailed description of material flow through a lake basin, in a form which is conducive to a single, comprehensive analysis leading to computer simulation studies. (Huff-Wisconsin)
W70-05420

THE 'SOFT' FACTORS IN SYSTEMS STUDIES,
Rand Corp.
James R. Schlesinger.
Bulletin of the Atomic Scientists, Vol 24, No 9, p 12-17, Nov 1968.

Descriptors: *Systems analysis, *Decision making, *Methodology, Operations research, Management, Social aspects, Political aspects, Institutional constraints.
Identifiers: *Policy, Bureaucratic structures.

This article provides insight into the limitations of systems studies and the manner in which policymakers use these studies. Three major themes are discussed. First, in systems studies the self-imposed limitation of playing down the broader political factors is defensible up to a point in the attempt to deal with a critical portion of the overall problem. Starting with the accepted 'political wisdom' may so corrupt the analysis that one never understands some of the fundamentals. Second, the chief difficulties arise in the transition from these 'suboptimized' analytical studies to decision making. In this respect analysts may have been remiss in failing to appreciate the crucial role of bureaucratic structures. Third, all important system studies--even when stated to be limited and 'suboptimized'--inevitably incorporate a number of non-technical assumptions, though typically in a tangential and implicit fashion. Without careful examination of the non-technical factors, adopting the conclusions of such specialized studies may be detrimental to policy. (Davis-Chicago)
W70-05437

A WATER BALANCE CONTROL-THEORETIC MODEL FOR REGIONAL MANAGEMENT,
British Columbia Univ., Vancouver; and Aria-Mehr University, Tehran (Iran).
Gary R. Gates, and Morteza Anvari.
Geographical Analysis, Vol 2, No 1, January 1970, p 19-29, 1 fig, 6 ref, 1 append.

Descriptors: *Management, *Methodology, *Planning, Water resources, Costs, Economic efficiency, Evaluation, Hydrologic aspects, Water balance.
Identifiers: *Control-theoretic model, *Water resource management, Cost effectiveness.

In response to the need for improved management methodology for politically-bounded regions such as provinces and states, a control-theoretic model for minimizing the cost of making desired hydrologic changes is outlined. The model is based on the premise that physical-hydrological processes within a region and cost-effectiveness of possible changes can be estimated with sufficient accuracy for systematic treatment. Several features are noteworthy in the model: (1) it incorporates the notion of the water balance on a systematic basis, (2) the decision maker specifies the state to be attained, (3) the model incorporates both the physical changes in quantities of water and the economic costs of making the changes, and provides a means for realizing desired objectives at least cost, (4) few unreasonable conditions are required for a solution, and (5) the model is conceptually simple and falls within a developed field of mathematics. It is concluded that a control theoretic model of the form: $dy(t)/dt = P(t)y(t)+Q(t)x(5)$, might eventually be a useful tool for managing water resources. However, before this will be possible, a means for establishing the functions must be developed and demonstrated. (Davis-Chicago)
W70-05438

SCIENCE AND THE CITY: THE QUESTION OF AUTHORITY,
Library of Congress, Washington, D.C. Legislative Reference Service.
James D. Carroll.
Science, Vol. 163, 28 February 1969, p. 902-911, 1 tab, 89 ref.

Descriptors: *Research and development, *Planning, *Institutional constraints, Social aspects, Political aspects, Governments.
Identifiers: *Metropolitan water resources management, *Urban programs.

An important aspect of urban programs is the problem of water resources development. Insights into this problem are provided by a discussion of the social authority and social relevance of public science and technology as it relates to the HUD research and development programs. Authority depends largely upon the capacity of an individual or an organization to satisfy expectations and values. However, the needs of modern society have resulted in a science based authority of knowledge which frequently supersedes the traditional authority of tradition and law. Accordingly, in many areas of government responsibility, science and technology have served to increase governmental effectiveness. However, this is not true of urban development where the lack of research traditions relating to urban development and the uncertainty over the meaning of 'urban science and technology' and 'urban research and development'. The HUD reaction is a research and development effort attempting to relate processes of law and government to processes of science and technology for the purposes of urban development. If successful, it should increase the effectiveness of legal and governmental action in urban areas. (Davis-Chicago)
W70-05441

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
For primary bibliographic entry see Field 06D.
W70-05461

6B. Evaluation Process

A CRITERION FOR APPRAISAL OF ECONOMIC DEVELOPMENT PROJECTS,
California Univ., Los Angeles.
Fereidoun Mobasheri.
Eng Econ, Vol 15, No 1, p 9-27, Oct-Nov, 1969. 19 p, 31 ref.

Descriptors: Economics, *Benefit-cost ratios, Benefits, Value, *Social values, *Discount rate, Interest rate, Payment, Capital costs, Return (Monetary), *Economic feasibility, Bibliographies, *Foreign projects, Foreign countries, Capital, Evaluation, Appraisals, Synthesis, Labor, *Investment, Decision making.
Identifiers: *Developing countries, Operation and maintenance costs, Labor costs.

An economic evaluation criterion is synthesized for calculating the social benefit and cost of engineering projects in developing nations. The framework of the synthesized criterion is the concept of benefit-cost analysis. Modifications are accomplished so that national goals and important economic characteristics of developing countries are reflected in the decision making criterion. The modifications are made possible by introducing concepts such as the social rate of discount, the social opportunity cost of capital, the reinvestment of some portion of benefits from the project, and the shadow prices for production factors and products. (USBR)
W70-05220

TARBELA--THE LARGEST DAM IN THE WORLD.
For primary bibliographic entry see Field 08A.
W70-05244

THE ECONOMIC IMPACT OF DROUGHTS ON WATER SUPPLY SYSTEMS IN THE PASSAIC RIVER BASIN, NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-05275

ESTIMATING THE PRODUCTIVITY OF IRRIGATION WATER,
Hawaii Univ., Honolulu.
Howard C. Hogg, Lloyd B. Rankine, and Jack R. Davidson.
Agricultural Economics Research, Vol. 22, No. 1, pp. 12-17, Jan. 1970, 6 p, 2 fig, 3 tab, 8 ref.

Descriptors: *Irrigation efficiency, *Productivity, Agronomy, Water costs, Water demand, Regression analysis.
Identifiers: *Production function, Short-run cost curves, Product supply curves.

Known agronomic relationships are incorporated in a production function estimated from field records of two Hawaiian sugar plantations which use sugarcane irrigation. An equation is developed to estimate the water-yield relationship for sugarcane. A hypothetical relationship between yield and soil moisture is examined. An empirical example is included. The conclusion states that when production functions are estimated from yield records, the incorporation of known agronomic principles can lead to improved estimates. The production function is used to estimate optimum irrigation level as a function of water cost, a static factor demand relationship for irrigation water, short-run cost curves, and product supply curves. (Grossman-Rutgers)
W70-05282

THE VALUE OF INLAND WATERFRONT INDUSTRIAL SITES,
Illinois Univ., Urbana. Dept. of Geography.
David M. Solzman.
Land Economics, Vol. 45, No. 4, pp 456-462, Nov. 1969. 7 pp, 5 fig, 3 tab, 3 ref.

Descriptors: *Property values, *Sites, Industrial plants, Recreation.
Identifiers: *Chicago.

The assumption that waterfront sites for urban industries are a necessity and that such sites should be reserved for industries which exhibit a distinctive water orientation, is examined. The area investigated is the city of Chicago, the south branch of the Chicago River, and the in-city and near-city portions of the Chicago Sanitary and Ship canal. At present, only one-half of the establishments sited along the waterway make direct use of it. Of those that do use the waterway, almost all use it for transportation, the highest-value use according to the executives of waterway firms. The findings indicate a declining trend of direct waterway usage. The conclusion states that the best development for close-in, riverport lands may well be for parks and recreational uses to enhance the image of the central city and upgrade the amenities and quality of life in this area. (Grossman-Rutgers)
W70-05284

POLUTION AND POVERTY: THE STRATEGY OF CROSS-COMMITMENT,
For primary bibliographic entry see Field 05C.
W70-05285

ECONOMIC AND SOCIAL IMPACT OF RECREATION AT RECLAMATION RESERVOIRS
Denver Research Inst., Colo., Industrial Economics Div.
J. Gordon Milliken, and H. E. Mew, Jr.
Available from the Clearinghouse as PB-188 544, $3.00 in paper copy, $0.65 in microfiche. Mar 69, 216 p., 9 figs, 33 tabs, 220 refs. Prepared for the Bureau of Reclamation.

Descriptors: *Economics, *Colorado, *Dams, *Recreation, Reviews, Rural areas, Social impact, Economic impact, Cities, Recreation demand, Recreation facilities, Reservoirs, Water reports, Expenditures, Land development, Tourism.
Identifiers: Shadow Mountain reservoir, Granby reservoir, Horsetooth reservoir.

Three reclamation reservoirs in Colorado were studied, twenty years after construction, to determine the economic and social impact of recreation. Two were remote scenic mountain reservoirs (studied as a single area); the third was a foothills reservoir near a city of 40,000 population. Methodology included questionnaires and interviews with recreationists and businessmen, and analysis of land value changes. Substantial direct economic impacts are discussed for both reservoir areas. Socio-cultural impact also was studied and significant differences are noted between typical groups of recreationists using the two reservoir areas.
W70-05312

A WATER BALANCE CONTROL-THEORETIC MODEL FOR REGIONAL MANAGEMENT,
British Columbia Univ., Vancouver; and Aria-Mehr University, Tehran (Iran).
For primary bibliographic entry see Field 06A.
W70-05438

WATER QUALITY MANAGEMENT: FIRST ANNUAL REPORT.
Miami Conservancy District, Dayton, Ohio. Water Conservation Subdistrict.

Dayton, Ohio, Miami Conservancy District, August 1969. 97 p, 31 fig, 17 tab, 5 map.

Descriptors: *Planning, Water quality control, Regional analysis, Water utilization, *Project planning, Project life, Streamflow, Water quality, Sampling, Ecology, Data processing, Computers, Model studies, Waste assimilative capacity.
Identifiers: Great Miami River, Water quality standards, Surveillance, Alternative programs.

This report represents the Official Plan, Phase One, of the Water Quality Management Program being carried out by the Miami Conservancy District. This plan is an action program directed toward implementing a regional system which will protect and enhance uses of the Great Miami River. Section 3 introduces the program, discusses related programs of other agencies, and describes advisory groups. Section 4 describes the Water Quality Standard adopted by the Ohio Water Pollution Control Board. The Standard defines water quality goals for the Great Miami River and the means and schedule for attaining them. Section 5 discusses streamflow and observed water quality conditions of the river. Section 6 summarizes the activities carried out by the District in 1968: (1) sampling network; (2) cooperative sampling programs; (3) surveillance program; (4) ecological studies; (5) data processing and computer usage; (6) stream quality models; (7) evaluation of specific alternatives; (8) projection of waste loads; and (9) systems analysis. Section 7 discusses caretaking activities at levees, channels, and dams. Section 8 describes the personnel and consultants engaged in programs of the District. Section 9 gives a list of selected reports and memoranda. (Gossen-Chicago)
W70-05440

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
For primary bibliographic entry see Field 06D.
W70-05461

MARGINAL VALUE OF IRRIGATION WATER AND A CASE STUDY OF TRANSFER IN SOUTHEASTERN WYOMING,
Wyoming Agricultural Experiment Station, Laramie.
For primary bibliographic entry see Field 03F.
W70-05462

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

DETERMINING RATE OF RETURN BY MEANS OF PAYBACK PERIOD AND USEFUL LIFE,
San Jose State Coll., Calif.
Donald G. Newnan.
Eng Econ, Vol 15, No 1, p 29-39, Oct-Nov, 1969. 11 p, 6 fig, 11 ref.
Identifiers: Engineering economy, Analytical method.

The payback period is an important and widely used measure of the economic attractiveness of an investment opportunity. The concept is easy to understand and is readily computed by several methods, but these methods give misleading results. Nevertheless, payback period determination may be considered an effective intermediate step in computing the after-tax rate of return. Conversion techniques must be simple to encourage the use of rate of return as the decision criterion rather than payback period. The relationships between payback period and rate of return are developed for before-tax and after-tax situations. If the tax consequences are to be considered, the tax rate and depreciation method must be known in addition to payback period and useful life. The equations derived for computing the rate of return are plotted for selected values of the parameters; the resulting curves provide a simple means for determining the rate of return when the payback period is known. (USBR)
W70-05219

6D. Water Demand

WATER CONSUMPTION STATISTICS IN THE TEXTILE INDUSTRY WITH SPECIAL REFERENCE TO THE FINISHING INDUSTRY,
For primary bibliographic entry see Field 05G.
W70-05130

REPORT UPON ADEQUATE WATER SUPPLY FOR THE CHICAGO METROPOLITAN AREA--1969 TO 2000,
Alvord, Burdick and Howson, Chicago, Ill.
D. E. Eckman, and L. R. Howson.
September 1969. 235 p, 38 fig, 39 tab.

Descriptors: *Water demand, *Water supply, *Water resources, *Water works, *Water distribution, *Municipal water, *Cities, *Lake Michigan, *Planning, *Construction costs, Engineers estimates, Construction, Water rates.
Identifiers: *Chicago Water Works, *Chicago Department of Water and Sewers.

The report is a detailed account of an engineering investigation of water service requirements, and the costs of facilities required in meeting anticipated demands upon the Chicago Water System, to the year 2000. Chicago presently withdraws 4 million tons of water per day from Lake Michigan, purifies it in the world's two largest filtration plants, and delivers it through several thousand miles of tunnels and water mains to nearly five million persons in Chicago and 72 suburban communities. The engineers estimated that the population served by the year 2000 will be 6,105,100, in Chicago and 94 outlying communities. The average daily pumpage requirement will probably increase from 1,024 MGD in 1968 to 1,298 MGD by the year 2000. The two filtration plants will be adequate; however, pumping facilities, tunnel conduits, and feeder mains must be provided. The total capital required, at 1969 prices, to the year 2000 is $370,432,000. Of this, $104,266,000 is included in the present 5-year Water Works Capital Improvement Program (1969-1973). Additional capital requirements for new facilities between 1970 and 2000 is estimated at $58,266,000; and replacements and rehabilitation at $207,900,000. If built progressively, to the year 2000, anticipated expenditures are estimated at $633,255,000. An increase in water rates is considered necessary to meet current costs of operation and to provide funds for new construction. (Poertner-Chicago)
W70-05255

CHARACTERISTICS OF SUPPLY AND DEMAND IN OUTDOOR RECREATION,
Economic Research Service, Washington, D.C.
Hugh A. Johnson.
Agricultural Economics Research, Vol. 22, No 1, pp. 18-23, Jan. 1970. 6 p, 1 tab, 6 ref.

Descriptors: *Recreation demand, Access routes, Recreation facilities.
Identifiers: *Recreation supply.

Most studies in outdoor recreation are actually user studies. Ten categories of outdoor recreation cover 90 percent of the preferences. Each category has unique demand limitations and unique spatial requirements. A main factor of demand is that people have to travel to outdoor recreation locations. The supply of outdoor recreation depends partially on the limitations that someone usually must provide access, develop facilities, and provide services. Private enterprise will supply outdoor recreation facilities where the opportunities are the best, such as in or near densely populated areas. Opportunities for private enterprises weaken as dependence on services and facilities decreases. (Grossman-Rutgers)
W70-05281

THE NATION'S WATER RESOURCES (REVIEW ARTICLE),
Wisconsin Univ., Madison. Dept. of Urban and Regional Planning.
Irving K. Fox.
Land economics, vol. 45, No. 4, pp. 474-476, Nov. 1969. 3 pp, 6 ref.

Descriptors: *Assessments, Water supply water resources planning act.
Identifiers: *Water resources council.

A brief history leading to the publication of the report, the Nation's Water Resources, is given. Six difficult conceptual and analytical problems are presented: (1) In view of the high cost, relative to value, of transporting water, what is the market area for which a given supply is relevant. (2) How are differences in quality to be taken into account. (3) How is demand to be measured when so many uses are not priced or are marketed at subsidized prices. (4) What is the relevant measure of use. (5) For withdrawal uses alone, what is the measure of use and in particular what account is to be taken of the return flow which for most uses is very large. (6) Finally, there is present the hazards of projecting into the future on a regional basis in the face of rapidly changing technological, economic, and social conditons. The ability of the report made by the Water Resources Council to overcome these problems is examined. (Grossman-Rutgers)
W70-05283

A MULTISTRUCTURAL DEMAND MODEL FOR WATER REQUIREMENT FORECASTING (FINAL REPORT),
Oklahoma Univ., Norman. Bureau of Water Resources Research.
George W. Reid.
Available from the Clearinghouse as PB-190 813, $3.00 in paper copy, $0.65 in microfiche. Oklahoma University Research Institute Project 1626, Final report to Office of Water Resources Research, January 1970. 236 p, 27 fig, 25 tab, 73 ref, 2 append. OWRR Project C-1023 (No 1574).

Descriptors: *Water demand, *Water supply, *Water resources development, *Systems analysis, *Optimization, Computer programs, Water utilization, Water systems, Model studies, Mathematical models, Statistical models, Economics, Social aspects.
Identifiers: Water demand model.

A 'people needs' mathematical model, multistaged, multivariant, or multistructured and fully computerized was developed to forecast future water requirements. The economic model for projecting municipal sector requirements will provide public, private, and service sector needs under various life style goals for either possible or probable worlds articulated over time and adjustable to revised goals. The model has a national base using resource concepts. The basic model uses both demographic and economic imputs and provides, through shift analyses, adjudicated sector outputs. The economic model is adaptable to a variety of technical models or procedures to produce municipal and industrial water requirements. The model has been used on a major city, it is completely computerized, and can be easily used for other essential services such as sewage, storm water, transportation, housing, etc. On regional or basin bases, irrigation, municipal, power, and other uses of water can be balanced. This flexible demand model can be used as a tool on a wide variety of supply-demand studies. (Knapp-USGS)
W70-05461

MINERAL AND THERMAL WATERS OF BELGIUM (FRENCH),
For primary bibliographic entry see Field 02F.
W70-05488

6E. Water Law and Institutions

WATCH BOATS.

Del Code Ann tit 7, secs 2701-2706 (Supp 1966).

Descriptors: *Delaware, *Boats, *Commercial shellfish, *Regulation, Oysters, Permits, Beds, Conservation, Legislation, State governments, Jurisdiction, Control, Dredging, Commercial fishing.
Identifiers: *Watch boats, *Law enforcement, Crimes, Trespass, Boat crews, Legal actions, Wardens, Penalties (Criminal).

Enforcement of shellfish laws and protection of oyster beds shall be accomplished by watch boats. The boats shall cruise over oyster plantations and natural beds for the purpose of preventing depredation by trespassers. On board each watch boat shall be a list of licensed oyster planters, dredgers and crew members of each dredge. If any person resists the crew of a watch boat, he shall be fined or imprisoned and fined, depending on whether life is endangered or lost in such resistance. If life is taken by the resisting party, he is guilty of murder in the first degree. The boat crews may use any force necessary to enforce the law, and may plead their duties under this title as a defense in any criminal or civil action against them. Upon command of the person in charge of the watch boat, any other boat shall aid in seizure of boats, crew members, and everything on any vessel used in violation of this title. On the Broadkiln and Mispillion rivers a suitable watch boat shall be used with a warden and other necessary persons on board. Wardens and other crew members shall be appointed by the Governor and shall meet residence requirements of this statute. (Harris-Florida)
W70-05222

HARBORS AND NAVIGATION (BOARDS OF HARBOR COMMISSIONERS).

Wis Stat Ann secs 30.37, 20.38 (1964).

Descriptors: *Wisconsin, *Harbors, *Administrative agencies, *Cities, Navigable waters, Public health, Safety, Planning, Administration, Ships, Construction, Leases, Maintenance, Docks, Railroads, Airports, Boats, Marinas, Transportation, Bridges, Cost allocation, Supervisory control (Power).
Identifiers: *Commercial aspects.

Any municipality situated on a navigable waterway may create a board of harbor commissioners. Once created, the board is largely independent of the municipality which created it. The powers and duties of such a board shall include: (1) operation of publicly-owned wharf and terminal facilities; (2) leasing of publicly-owned harbor lands or facilities to any party; (3) assignment of berths and maintenance of guards at publicly-owned harbor facilities; (4) operation of municipal airport facilities contiguous to the harbor area; (5) operation of municipal harbor craft such as fireboats and tugs; and (6) general planning to improve the harbor for public purposes. The boards shall be funded and their expenditures accounted for as prescribed by statute. (Dearing-Florida)
W70-05241

CITIES AND VILLAGES ACT (ACQUISITION OF PUBLIC BEACHES).

Ill Ann Stat ch 24, sec 21-18 (Smith-Hurd 1962).

Descriptors: *Illinois, *Recreation facilities, *Local governments, *Land use, Beaches, Cities, Water resources development, City planning, Shores, Legislation, Project planning, City planning.

The city of Chicago may acquire municipal parks, play grounds, public beaches, and bathing places and improve, maintain, and regulate the same. (Hubener-Florida)
W70-05243

RELINQUISHMENT OF CLAIMS AND ISSUANCE OF PATENTS TO CERTAIN REAL ESTATE.
Ind Ann Stat sec 62-401 (1962).

Descriptors: *Indiana, *Patents, *Real property, *Riparian land, Legislation, Legal aspects, Land, Land tenure, Rivers, State governments.

The Governor is authorized and directed to issue patents to certain described real estate bordering the Little Calumet River. (Powell-Florida)
W70-05248

MOSQUITO CONTROL (MOSQUITO EXTERMINATION COMMISSIONS).
Pa Stat Ann tit 16, secs 11854, 11855 (1956).

Descriptors: *Pennsylvania, *Mosquitoes, *Aquatic insects, *Insect control, Administrative agencies, Insecticides, Insects, Larvicides, Larvae, Public health, Breeding, Abatement, Cost repayment, Assessments, Water supply, Cities, Legal aspects, Legislation.
Identifiers: *Public nuisance.

Each county mosquito extermination commission shall have the power to eliminate all mosquito breeding places on public or private property and may enter such property and do all necessary acts for the elimination of such breeding places. Any water in which mosquito larvae breed is declared to be a public nuisance and must be abated by the owner or, if the owner fails to abate the nuisance, by the commission. The cost of such abatement may be assessed against the landowner. No order of abatement shall in any way affect any waters used or reserved for the supply of water to the public, whether by a municipality or by a water company. (Dearing-Florida)
W70-05301

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME I: INTRODUCTION, CHAPTERS 1 AND 2.
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 714, $3 in paper copy, 65 cents in microfiche. Nov 69, 289 p.

Descriptors: *Continental shelf, *Economics, Planning, Natural resources, International law, Fish, Industries, Sulfur, Water pollution, Pipes, Atlantic Ocean, Pacific Ocean, *Legislation, Mineralogy, Oil, Gulf of Mexico, Fisheries, Pipelines, Public lands.

Contents: Introduction; Legal aspects (International considerations. Allocation of federal jurisdiction over activities on or affecting the outer continental shelf. Background of the Submerged Lands Act and Outer Continental Shelf Lands Act, Administration of the Outer Continental Shelf Lands Act); Resource aspects (Known and potential resources of the outer continental shelf, Living resources of the continental shelf, Anticipated

development of offshore mineral industry and technology, Economic analysis of leasing experience under the Outer Continental Shelf Lands Act, An economic analysis of prorationing of production). (See also W70-05307).
W70-05306

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME II: (CHAPTERS 3 THROUGH 7).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 715, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 336 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Standards, Drilling, Fish, Industries, California, Texas, Louisiana, *Legislation, Minerology, *Public lands, Beds, Oil.

Contents: Background of the submerge lands act and outer continental shelf lands act; Administration of the outer continental shelf lands act; Living resources of the continental shelf; Anticipated development of offshore mineral industry and technology. (See also W70-05308)
W70-05307

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME III: (CHAPTERS 8 THROUGH 12).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 716, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 249 p.

Descriptors: *Continental shelf, *Economics, Gases, Natural resources, Planning, Drilling, Standards, Louisiana, *Legislation, Oil, Mineralogy, Gulf of Mexico, Seashores, *Leases.

Contents: Economic analysis of leasing experience under the Outer Continental Shelf Lands Act; An economic analysis of prorationing of production; User interaction and environmental impact; Analysis of the existing system of administration of outer continental shelf lands; Analysis of alternatives to existing system. (See also W70-05309)
W70-05308

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES. VOLUME IV: (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott Krueger, and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 717, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 397 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Drilling, Sulfur, Gases, Shales, Deep water, Manganese, Hawaii, California, Texas, Louisana, Alaska, Oregon, *Legislation, Mineralogy, Oil, Exploration, Public lands, Leases, Gases.

Contents: Truman proclamation; Convention on the continental shelf; Convention on the territorial sea and the contiguous zone; Convention on the high seas; Convention on fishing and conservation of the living resources of the high seas; Public law 89-658; 80 Stat. 908 fishery zones--extra-territorial sea; Marine Resources and Engineering Development Act of 1966; A discussion of the legislative history and possible construction of the Convention on the Continental Shelf; U.N. resolution establishing the Ad Hoc Committee to study peaceful uses of the sea-bed and the ocean floor beyond the limits of national jurisdiction; Proposal of the permanent Mission of Malta; Draft resolution of United States to Ad Hoc Committee; Submerged Lands Act; Outer Continental Shelf Lands Act; Regulations - Bureau of Land Management; Regulations - U.S. Geological Survey; Exchange of correspondence between the Department of the Interior and the Department of the Army regarding review of applications for permits; Potential Mineral Resources of the United States Outer Continental Shelf; Report of the Secretary General to the United Nations Economic and Social Council on the Resources of the Sea. (See also W70-05310)
W70-05309

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES, VOLUME V (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 718, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 399 p.

Descriptors: *Continental shelf, Gases, Natural resources, Planning, Bibliographies, California, Louisiana, Texas, Alaska, Oregon, Hawaii, *Legislation, Mineralogy, Leases, *Public lands.

Contents: Bibliography and source list; Questionnaire to industries; Notices concerning oil and gas leasing; Summaries of salt water angling and collisions involving offshore structures; Work statement; Comparative laws and policies (domestic). (See also W70-05311)
W70-05310

STUDY OF OUTER CONTINENTAL SHELF LANDS OF THE UNITED STATES, VOLUME VI: (APPENDICES).
Public Land Law Review Commission, Washington, D.C.

Revision of report dated Oct 68. Prepared in cooperation with Nossaman, Waters, Scott, Krueger and Riordan, Los Angeles, Calif. Available from the Clearinghouse as PB-188 719, $3.00 in paper copy, $0.65 in microfiche. Nov 69, 220 p.

Descriptors: *Continental shelf, *Economics, Natural resources, Standards, Alaska, California, Louisiana, Oregon, Texas, *Legislation, Mineralogy, Cost analysis, *Leases, *Public lands.

Contents: Offshore mineral leasing experiences of coastal states; Comparitive laws and policies (foreign); Compilation of alternatives; Department of the Interior reports. (See also W70-05306)
W70-05311

THE CONSTITUTIONALITY OF EFFLUENT CHARGES,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05G.
W70-05320

APPLYING BACTERIOLOGICAL PARAMETERS TO RECREATIONAL WATER QUALITY,
For primary bibliographic entry see Field 05A.
W70-05332

THE OCEANS' RESOURCES AND INTERNATIONAL LAW-POSSIBLE DEVELOPMENTS IN REGIONAL FISHERIES MANAGEMENT,
Loyola Univ., Los Angeles, Calif. School of Law.
L. F. E. Goldie.
Columbia Journal of Transnational Law, Vol 8, No 1, p 1-53, Spring 1969. 53 p.

Descriptors: *Law of the sea, *Resource development, *Commercial fishing, *International waters, Legal aspects, Fish conservation, Fish control agents, Fishing, Fish management, Marine fisheries, Regulation, Legislation, Oceans, Continental shelf, International law, Treaties, Regime.
Identifiers: Maximum sustainable yield.

The traditional approach of international law to the use of the seas for fishing divides the seas into two categories: those under the sovereignty of a coastal state and the 'free high seas,' beyond the sovereignty of any state. Marine resources of the high seas are common property, open to the first man who can reduce them to his effective possession. This law of the sea is based on the assumption that the oceans' resources are inexhaustible and all may freely fish without causing detriment to others. The need for international cooperation in exploiting and conserving high seas' fishing must foster original approaches to man's legal relations to the sea. Regional fishery regimes with authority to give economic direction and pursue conservation goals are suggested to enhance exploitation of marine fisheries. The facilities offered by the Geneva Convention on Fishing and Conservation of the Living Resources of the High Seas are analyzed towards this end. Various forms of managerial approaches and criteria for granting access to marine resources are examined. The multinational public enterprise is recommended as an alternative to traditional legal concepts to resolve international fisheries disputes. (Cuevas-Florida)
W70-05333

REASONABLE STATE REGULATION OF THE INTERSTATE TRANSFER OF PERCOLATING WATER,
Cornell Univ., Ithaca, N.Y. School of Law.
Michael D. White.
Natural Resources Lawyer, Vol 2, No 4, p 383-406, Nov 1969. 24 p. OWRR Project A-006-NY.

Descriptors: *Percolating water, *Hydrologic cycle, *Interstate compacts, *Water management (Applied), Underground streams, Well permits, Well regulations, Regulation, Legislation, State governments, Federal government, Subsurface flow, Subsurface waters, Aquifers, Surface waters, Legal aspects, Judicial decisions, Riparian rights, Reasonable use, Prior appropriation, Water pollution, Geohydrologic units, Groundwater, Hydrogeology, Water transfer.

Significant problems of water supply result in the transfer of substantial quantities of water between states. Although the federal government has not acted, the inequality of water supply existing between states indicates the need of an integrated national approach to the problem. The states have a protective interest regarding their water supply and legislate anti-export statutes to provide conservation of this resource. This may be in violation of the Commerce Clause when viewing water as an article of commerce. Cases construing this point are discussed. There are five types of percolating water jurisdiction. They are those adhering to the: (1) absolute privilege doctrine; (2) Forbell version of the reasonable use doctrine; (3) the Restatement of Torts version of the reasonable use doctrine; (4) the correlative rights doctrine; and (5) a statutory version of the prior appropriation doctrine. The validity of anti-export statutes is demonstrated by examining the statute of one state in each type of percolation jurisdiction. In proposing state non-discriminatory protective legislation based on valid conservation ideas, it is concluded that the reasonableness of anti-export statutes is uncertain as a violation of the Commerce Clause. (Barnett-Florida)
W70-05334

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE,
For primary bibliographic entry see Field 04B.
W70-05335

PROJECT GROUNDWATER PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGAL RIGHTS TO GROUNDWATER),
For primary bibliographic entry see Field 04B.
W70-05336

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-EXCESS LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05337

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE EXCESS LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05338

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (THE NON-PROJECT LANDOWNER PROBLEM),
For primary bibliographic entry see Field 04B.
W70-05339

PROJECT GROUNDWATER: PROBLEMS AND POSSIBLE SOLUTIONS IN APPLICATION OF THE FEDERAL RECLAMATION ACT TO A DISPUTED RESOURCE (LEGISLATIVE PROPOSALS),
For primary bibliographic entry see Field 04B.
W70-05340

RURAL WATER DISTRIBUTION SYSTEMS: AN ANALYSIS OF CREATING A LOCAL SYSTEM,
William L. Latham.
Mississippi Law Journal, Vol 40, No 3, p 425-438, May 1969. 14 p, 1 append.

Descriptors: *Rural areas, *Project planning, *Water distribution (Applied), *Government finance, Mississippi, Distribution systems, Public utilities, Federal government, Water resources development, Legal aspects, Federal project policy, Regulation, Legislation, Programs, Project purposes, Costs, Financing, Loans, Grants, State governments, Community development.
Identifiers: Farmers Home Administration.

The availability of federal funds necessary to establish a rural water system is examined with emphasis on the Farmers Home Administration program. Federal assistance requirements and guidelines governing funds distributed through FHA for rural water projects are analyzed in detail. Such aspects as source and types of funds available, development cost of the project, definition of rural area, and problems of preliminary design are discussed. It is suggested that a general construction plan and customer survey for the proposed service area be submitted to demonstrate the project's conformity to community development. Mention is made of Mississippi's experience in obtaining FHA funds. The Mississippi Public Service Commission has jurisdiction over water distribution systems. Procedural requirements necessary to obtain permission to construct and operate a rural water system are listed. An appendix contains a sample petition for a certificate of convenience and necessity. Rural water associations are subject to rate regulation unless their officers are elected by consumers or appointed by the county board of supervisors. Regulation of all water systems' services remain under the Commission. (Cuevas-Florida)
W70-05341

LEGAL CONTROL OF WATER POLLUTION.
For primary bibliographic entry see Field 05G.
W70-05342

STATE CONTROL OF WATER POLLUTION: THE CALIFORNIA MODEL.
For primary bibliographic entry see Field 05G.
W70-05343

WATER POLLUTION CONTROL THROUGH INTERSTATE AGREEMENT.
For primary bibliographic entry see Field 05G.
W70-05344

FEDERAL PROGRAMS FOR WATER POLLUTION CONTROL.
For primary bibliographic entry see Field 05G.
W70-05345

SPECIAL PROBLEMS OF WATER POLLUTION: THE PRIVATE SECTOR.
For primary bibliographic entry see Field 05G.
W70-05346

POLLUTION OF GROUNDWATER.
For primary bibliographic entry see Field 05G.
W70-05347

POLLUTION OF THE SEA.
For primary bibliographic entry see Field 05G.
W70-05348

SAN JOAQUIN DELTA: IS NEGOTIATION A SOLUTION.
For primary bibliographic entry see Field 05G.
W70-05349

ESTABLISHMENT OF STATE, COUNTY, AND CITY BRIDGE COMMISSIONS.

Ohio Rev Code Ann secs 5593.01 thru 5593.19 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Bridges, *Bridge construction, *Administrative agencies, Legislation, Legal aspects, Political aspects, Local governments, Taxes, Navigation, Rivers, Navigable waters, Eminent domain, Condemnation, Right-of-way, Construction costs, Highways, Supervisory control (Power), State governments, Jurisdiction, Financing.

The State Bridge Commission of Ohio is created and authority is granted to counties and cities to establish local bridge commissions. These commissions may: (1) construct, acquire by purchase or condemnation, maintain, and operate any bridge; (2) issue bridge revenue bonds; (3) fix and collect tolls; (4) acquire by purchase or condemnation any property or rights in property necessary or convenient for the construction, improvement, or efficient operation of a bridge, or for securing rights-of-way leading to bridge approaches. The Director of Highways must approve all bridge commissions. Procedures for the issuance and funding of bridge revenue bonds are enumerated. (Casey-Florida)
W70-05357

ILLINOIS-MISSOURI BRIDGE COMMISSION.
Mo Ann Stat secs 234.430 thru 234.490 (Supp 1970).

Descriptors: *Missouri, *Interstate compacts, *Bridge construction, *Interstate commissions, Illinois, Mississippi River, Interstate rivers, Construction, Maintenance, Planning, Financing, Bridges, Costs, Contracts, Condemnation, Structures, Regulation, Easements, Administrative agencies, Legislation, Legal aspects, Supervisory control (Power), Operation and maintenance.
Identifiers: *Ferries, Bonds, Tolls.

The Governor, with the advice and consent of the senate, will appoint three commissioners to enter into a compact with Illinois. The Illinois-Missouri Bridge Commission is created with the following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Canton, Missouri; (2) to purchase, maintain and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries, and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs, and operation of the bridge, and to pay the principal and interest on outstanding bonds. The administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Illinois, the Commission will be dissolved. (Keith-Florida)
W70-05358

STATE V BILLIOT (CONFISCATION OF TRAWLS FOR ILLEGAL SHRIMP TRAWLING).

229 So 2d 72-76 (La 1969).

Descriptors: *Louisiana, *Shrimp, *Commercial fishing, *Trawling, Judicial decisions, Legislation, Legal aspects, Brine shrimp, Fishing, Nets, Wildlife, Wildlife conservation, Fish conservation, Oceans, Sea water, Marine fisheries, Administrative agencies, Fishing gear, Commercial shellfish, Wildlife management, State governments.
Identifiers: Confiscation, Penalties (Criminal).

Defendants were found guilty in a jury trial of trawling in inside waters for salt water shrimp during the closed season. The trial court, after sentencing the defendants, suspended sentence and ordered the Louisiana Wildlife and Fisheries Commission to return the trawls that had been seized at the time of the arrest. The state sought a writ of certiorari to contest the action of the trial court, contending that the Louisiana statute made the jail sentences and confiscation of equipment mandatory. The Supreme Court of Louisiana granted certiorari and reversed the trial court, holding that the general statute relating to the suspension of sentences for misdemeanors was not applicable to statutes making sentences mandatory. Defendants' contentions that the trawling statute was vague, violated due process, and constituted cruel and inhuman punishment were rejected by the court. The court held that the state has the power to deter the violation of its fish and game laws by the forfeiture of the equipment used in the illegal taking of such fish and game. (Schram-Florida)
W70-05359

COOK v WEINBERGER BUILDERS INC. (RIGHT OF ACCESS OVER PRIVATE EASEMENT ON PRIVATE LAND).

172 N W 2d 876-878 (Ct App Mich 1969).

Descriptors: *Michigan, *Access routes, *Easements, *Lakes, Judicial decisions, Right-of-way, Real property, Relative rights, Legal aspects, Land tenure, Land use, Water rights.

Both plaintiff and the individual defendants were lot owners in a subdivision. The subdivision contained a private lake dedicated to the use of certain owners with a twenty-foot private easement around the lake reserved for the use of public utilities. The easement gave the defendant lot owners access as far as the twenty-foot private easement, but to reach the lake, the final twenty feet had to be crossed. Defendants crossed this twenty feet over the land of the plaintiffs. Plaintiff's complaint was

dismissed by the trial court. The appellate court held that the dismissal was improper since the trial court failed to make findings of fact and to state its conclusions of law to support a judgment that the lot owners had access to the water over the private easement on plaintiff's land. (Douberley-Florida)
W70-05361

FROST v STATE (CONSTITUTIONALITY OF USING PRIMARY ROAD FUNDS FOR INTERSTATE BRIDGES).
172 N W 2d 575-588 (Iowa 1969).

Descriptors: *Iowa, *Bridge construction, *Interstate, *Financing, Judicial decisions, Bridges, State governments, Rivers, Interstate rivers, Mississippi River, Government finance, Interest, Planning, Financial analysis, Taxes, Operating costs, Construction costs, Maintenance costs, Reimbursable costs, Legislation, Illinois, Legal aspects.
Identifiers: *Interstate bridges, Bonds, Tolls, Road funds.

Plaintiff challenged the constitutionality of the Interstate Bridge Act and sought to enjoin the construction of a bridge by the State of Iowa connecting Iowa and Illinois. The state supreme court held that the tax levied was not a violation of due process, and that proper procedures for the construction has been followed. It held, however, that the portion of the Act which allowed primary road funds to be used in the initial construction and maintenance of the bridge was unconstitutional. The state constitution specified that certain of the taxes that made up the primary fund be used exclusively within the state. Using these funds to finance portions of the bridge in another state was a constitutional violation. The court struck down a part of the Act which did not allow the powers of the highway commission to be diminished, since this would unlawfully bind future legislatures. It also held that the commission could not issue bonds to repay moneys used from the primary road fund because the Act provided for repayment from tolls only. The remaining sections of the Act were found to be separable from the unlawful provisions and remained in force. (Douberley-Florida)
W70-05363

DRAKE V TOWN OF BOONTON (ASSESSMENTS FOR CONSTRUCTION OF WATER MAIN).

106 N J Super 79, 254 A2d 151-155 (1969).

Descriptors: *New Jersey, *Pipes, *Local governments, *Repayment contracts, Water supply, Judicial decisions, Legal aspects, Water users, Pipelines, Construction, Water conveyance, Water delivery, Water demand, Legislation, Water costs, Conduits, Construction costs, Contracts, Cities.

Plaintiffs sought to compel defendant municipality to supply plantiffs with water. Plaintiffs lived on a street serviced by a water main constructed by a private individual pursuant to a contract with defendant that defendant would maintain and operate the pipe and the builders of the main would be reimbursed by collecting a proportionate share of such installation costs from those wishing to tie-in to the main. Plaintiffs refused to make such payment. The contract between defendant and the individual was valid under a statute that gave defendant discretionary power to build such main. However, by providing a reimbursement clause for the individual, defendant abdicated its function of collecting water rents to a private individual. This was illegal and the plaintiffs could not be forced to make a payment to the individuals who constructed the water main. Since the main was owned and controlled by the municipality, defendant was required to supply water to the plaintiffs and to reimburse the individual who built the main from revenues collected from those who tied into the main. (Barnett-Florida)
W70-05364

THE QUALITY OF THE ENVIRONMENT: A REVIEW,
Toronto Univ. (Ontario). Dept of Geography.
For primary bibliographic entry see Field 06F.
W70-05373

MAN, WATER, AND ENVIRONMENT,
Water Pollution Research and Applications, Inc., Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-05384

RAILROADS-CONSTRUCTION AND OPERATION.

Iowa Code Ann secs 477.1-477.5 (1949).

Descriptors: *Iowa, *Railroads, *Engineering structures, Bridges, Roads, Highways, Navigation, Pipelines, Mississippi River, Missouri River, Channels, Legal aspects, Rivers, Riparian rights, Navigable rivers, Streams, Construction, Bridge construction, Road construction, Repairing, Shore protection, Piers, Coastal structures, Maintenance, Damages, Compensation, Legislation.

Any railroad company may build its railway across, over, or under any other railway, canal or watercourse whenever necessary. The company shall be liable for all damages caused by such crossing. The construction of such crossing shall not unnecessarily impede travel, transportation or navigation. All bridges, abutments or other construction used to cross over or under any watercourse, public highway or other railway must be kept in good repair. The railway company shall be liable for any damages sustained because of violation of this act. All riparian owners or lessees of land on the Iowa banks of the Mississippi or Missouri rivers are entitled to build all necessary adjuncts for the navigation of those rivers provided that such structures in no way impede navigation on those waterways. No railroad or other obstruction may be constructed between the riparian lots and the Mississippi and Missouri rivers unless the amount of injury to such property is ascertained and properly paid over to the owner or lessees of such damaged property. Any railway may lay and maintain pipes through any lands adjoining its tracks for 3/4 of a mile in order to conduct water for its engines from any running stream. (Barnett-Florida)
W70-05390

FEDERAL PROGRAMS RELATED TO ENVIRONMENT,
Library of Congress, Washington, D.C. Legislative Reference Service.
Elizabeth Boswell.
Washington: The Library of Congress Legislative Reference Service, 70-30 EP, TP 450, February 1, 1970. 72 p, 1 tab.

Descriptors: *Environment, *Federal government, *Administration, Institutions, Administrative agencies, Institutional constraints.

In recent weeks there has been a surge in activity in the Federal Government to set up new environmental administrative mechanisms, including some in-house reorganization of Federal departments. This report provides a compilation and brief description of the purposes, functions and activities of existing Federal agencies having programs which are significantly related to environmental concerns. Federal departments, independent agencies and selected boards, commissions and committees are included in the listing. (Davis-Chicago)
W70-05435

THE 'SOFT' FACTORS IN SYSTEMS STUDIES,
Rand Corp.
For primary bibliographic entry see Field 06A.
W70-05437

SCIENCE, VOTERS, AND THE FLUORIDATION CONTROVERSY,
Massachusetts Inst. of Tech., Cambridge.
Harvey M. Sapolsky.
Science, Vol 162, 25 October 1968, p 427-433. 2 tab, 50 ref.

Descriptors: *Fluoridation, *Social aspects, *Political aspects, Attitudes, Decision making, Public health.
Identifiers: *Voter behavior.

This examination of the fluoridation controversy attempts to illustrate more clearly the role of the citizen in a scientifically complex society. From this perspective, an analysis of the fluoridation controversy becomes a study in the relation between science and democracy. An analysis of studies of fluoridation campaigns suggests that the shift in opinion from positive to negative, is due to confusion that develops in the minds of the voters. The voters, although predisposed to favor fluoridation, are initially quite ill-informed about it. The public, believing the fluoridation issue to be a conflict among scientific experts, seeks the safest course. Unable to decide between what appear to be two contending scientific positions, the voters opt to avoid the greatest potential health risks by defeating the fluoridation proposals. This situation points to an important problem--what is the citizen's role in a society that seeks to be both scientifically advanced and democratic. Fluoridation seems to confirm the inappropriateness of direct citizen involvement in policy-making. The technical intracacies of the problem are too great for the average voter to resolve. Administrative agencies and legislatures, with their more deliberate procedures and their greater capacity to distinguish among experts, are more able to nationally consider questions of safety and efficacy. The need may be for new educational programs which would not train the citizens to be knowledgeable in the various fields of science, but rather would equip him to deal with scientific arguments and scientific experts, through understanding the limits and uses of science. (Davis-Chicago)
W70-05439

GAME, INLAND FISHERIES AND DOGS (STATE AND COUNTY FISHING LICENSES).

Va Code Ann secs 29-57 thru 29-60, 29-77.1 (1969).

Descriptors: *Virginia, *Fishing, *Permits, *Regulation, Water sports, Recreation, Legislation, Legal aspects, Water utilization, Trapping, Hunting, Wildlife, Water conservation, Tidal waters, Streams, Low water mark, Water types, Fish management, Water policy, Wildlife management, Fish conservation.
Identifiers: *Licenses, Penalties (Civil).

The persons entitled to county or state resident licenses to hunt, trap or fish are enumerated. Nonresidents are required to obtain a nonresident license. The residents of counties bordering a nontidal stream have the right to hunt, trap and fish in such stream opposite the shore line of the county for which such resident has a county license. The residents of counties bordering a tidal stream have such right to the low water mark or as far as the county limits of the county for which he has a license extends. Any person found guilty of violating any of the provisions of the hunting, trapping and/or inland fish laws twice within two years shall have his license by the court trying the case. (Powell-Florida)
W70-05446

FISHERIES AND GAME: STATE BOARD.

Conn Gen Stat Ann secs 26-18 thru 26-26 (1960), as amended, (Supp 1969).

Descriptors: *Connecticut, *Fish conservation, *Fisheries, *Fishing, Fish, Game birds, Administrative agencies, Boats, Boating, Regulation, Right-of-

way, Streams, Ponds, Forest fires, Fish management, Nutrient requirements, Fish diets, Legal aspects, Wildlife management, Animal control, Aquatic populations, Aquatic weed control, Legislation, State governments, Interstate.
Identifiers: *Fishing seasons.

It is unlawful to apply to the State Board of Fisheries and Game for any fish or game with the intent to use the same for purposes other than those stated in the application. Restrictions are placed on the use of boats in Bantam River. The Board shall erect signs to clearly indicate the location of rights-of-way to state ponds and streams. The Board may also remove any undesirable plants or animals from the waters of the state, or may add substances to the waters (subject to approval by the Department of Health) to increase the production of fish food organisms. The Governor may, when extraordinary measures are necessary to prevent forest fires, proclaim a closed season on sport fishing in inland waters. Such proclamation shall not apply to certain excepted areas. On waters lying between Connecticut and their respective states, officers of Rhode Island, Massachusetts and New York may enforce Connecticut fish and game laws. (Dearing-Florida)
W70-05447

PARK COMMISSIONERS.

Ill Ann Stat ch 105 secs 81 thru 85, 92, 94, 97, 98, 114 (Smith-Hurd 1952).

Descriptors: *Illinois, *Parks, *Local governments, Beds, Shores, Condemnation, Judicial decisions, Financing, Legislation, Construction, Contracts, Railroads, Reclamation, Docks, Harbors, Navigation, Cities, Canals, Levees, Piers, Riparian rights, Boundaries (Property).

The commissioners of Lincoln Park may acquire the riparian rights appurtenant to the shore lands and such submerged lands as are necessary to any plan for extension of the park. The new boundary lines may be established by proper suit in chancery. If the commissioners are unable to reach an agreement with the owners of the desired lands, then proceedings for condemnation may be instituted. The submerged lands thus acquired and the rights appurtenant thereto shall be held by the commission for the purpose of maintaining or extending the public park and facilities. The cost of such acquisition and construction may be paid out of general revenue or by interest bearing bonds. (Darragh-Florida)
W70-05449

LOCAL GOVERNMENT; LIMITATIONS ON INDEBTEDNESS.
Ill Ann Stat ch 85, secs 851.56, 851.17, 851.19 (Smith-Hurd 1966), as amended, (Supp 1970).

Descriptors: *Illinois, *Water resources development, *Water conservation, *Water management (Applied), Legislation, Legal aspects, Water utilization, Water supply, Flood control, Drainage, Sanitation, Navigation, Recreation, Ditches, Fish conservation, Channels, Water conveyance, Water control, Dams, Levees, Financing, Surface water, Sewers, Sewage treatment, Supervisory control (Power).

The river conservancy districts are organized under an act giving such districts the power to effectuate river and flood control, drainage, irrigation, conservation, sanitation, navigation, recreation, development of water supplies, and the protection of fish life. The surface water protection districts are organized for the purposes of acquiring, establishing, maintaining, and operating ditches, channels, flumes, or similar waterways or any other types of construction necessary for the collection of surface water within the district. The district is also formed to convey and dispose of such waters at suitable points of discharge. The statutory limitations of indebtedness do not apply to the river conservancy districts or the surface water protection districts. The limitations do not apply to any indebtedness for either acquiring, constructing, operating, or maintaining sewage facilities or sewage treatment plants incurred by any county under an act relating to water supply, drainage, sewage, pollution or flood control. (Powell-Florida)
W70-05450

INTERSTATE BRIDGES.
Iowa Code Ann secs 313A.1-313A.39 (Supp 1970).

Descriptors: *Iowa, *Bridges, *Bridge construction, *Administrative agencies, Highways, Civil engineering, Bridge design, Interstate rivers, Navigable rivers, Cities, Government finance, Financing, Condemnation, Right-of-way, Payment, Transportation, Operation and maintenance, Operating costs, Administrative costs, Construction costs, Maintenance costs, Cost sharing, Legislation, Legal aspects.
Identifiers: *Franchises.

The State Highway Commission may construct and acquire toll bridges as a part of any public highway across any navigable river between this state and an adjoining state. Such construction and acquisition is to be financed by the issuance of revenue bonds, by contributions from political subdivisions, and by tolls collected from the bridges. The Commission shall control the operation, maintenance and financing of these bridges and may also acquire rights-of-way to the bridges. Procedure is provided for determining the need for, and public interest in, establishment of a toll bridge in a particular location. Funding and expenditure provisions are also included. The Commission shall set the toll rate for all interstate bridges hereinfor provided. When it is deemed to be in the public interest, the Commission may sell land no longer needed for toll bridge purposes to the general public or to political subdivisions of the state. (Dearing-Florida)
W70-05451

CHAPTER XIII: PULP-MILL WASTE-WATER DISCHARGES INTO PUGET SOUND: AN INDUSTRY VIEWPOINT,
Northwest Pulp and Paper Association, Seattle, Wash.
For primary bibliographic entry see Field 05B.
W70-05453

CHAPTER XIV: THE CHANGING ROLE OF THE COURTS IN WATER-QUALITY MANAGEMENT,
Washington Univ., Seattle. School of Law.
Ralph W. Johnson.
In: Water Resources Management and Public Policy, ed. Thomas H. Campbell and Robert O. Sylvester, University of Washington Press, 1968, p 196-203, 4 ref.

Descriptors: *Civil law, *Water quality control, *Administrative agencies, *Administrative decisions, *Riparian rights, Decision making, Appropriation system, Reasonable use, Water zoning, Long-term planning.
Identifiers: *Statutory administrative law, *Model Water Use Act, Rational approach, Efficient approach, Pollution Control Commission, Court-centered system, Natural flow, Nuisance.

The increasing need for water-quality management and the stepped-up growth of law regarding it has brought about new legal developments in the past 25 years. Common-law control of water quality including the 'riparian rights' system and the appropriation system are summarized. The nature of each and their historical evolvements are traced with regard to change from a court-centered system to an administrative law system, and from 'natural flow' theory to 'reasonable use' theory. However, a number of limitations seriously impairing the usefulness of these legal remedies have brought about their gradual decline and replacement by administrative control. The element of uncertainty for industries under the riparian system led to the Model Water Use Act with a licensing program, but further problems are posed. Public interest tends to go unprotected; statutes of limitations and 'laches' may bar use of riparian rights; consistent policies tend not to evolve; enforcement is hit-or-miss; and expenses are simply too high. Limitations of the court system in handling continuing problems and the lack of necessary draining in legal judges recommend administrative agencies as a more rational and efficient approach. Nevertheless, courts still do play a significant part in the process through review of legislation and administrative action. (See W70-03995). (Preckwinkle-Chicago)
W70-05454

NAVIGABLE WATERWAYS (NAVIGABLE WATER CROSSINGS).

Ark Stat Ann secs 73-2201 thru 73-2216 (Supp 1967).

Descriptors: *Arkansas, *Navigable waters, *Pipelines, Electric cables, Administrative agencies, Safety, Ownership of beds, Streambeds, Public rights, Public utilities, Construction, Repairing, Operation and maintenance, Judicial decisions, Water rights, Cost allocation, Damages, Legal aspects, Legislation, Administration, Navigable rivers, Land tenure, Relative rights, Permits.
Identifiers: *Water crossings.

The Public Service Commission shall have the power to regulate, in the interest of public safety and public use of waterways, the construction, operation and replacement of all navigable water crossings. The Commission may grant title to state-owned waterway beds to private interests for the construction and maintenance of electric power lines and pipelines. Petitions from such river-crossing proprietors to the Commission must follow the specified form and procedure. Such petition should be granted unless the proposed navigable water crossing would jeoparidize the public safety or interfere with some other paramount public or private use of the waterway or its underlying bed. Once granted, the rights in respect to the crossing shall be perpetual. Decisions of the Commission are reviewable by the Circuit Court of Pulaski County and thereafter by the state supreme court. (Dearing-Florida)
W70-05459

PRIVATE TOLL BRIDGES AND FERRIES.

Ky Rev Stat Ann secs 280.020, 280.130, 280.140, 280.170, 280.210, 280.220, 280.300, 280.310 (1963).

Descriptors: *Kentucky, *Bridges, *Boats, Engineering structures, Legislation, Legal aspects, Bridge construction, Civil engineering, Piers, Maintenance, Construction, Highways, Docks, Condemnation, Navigable waters, Streams, Rivers, Banks, Bank protection, Local governments, State governments, Federal government, Operation and maintenance, Interstate.
Identifiers: *Ferries.

A certificate of convenience and necessity obtained from the Department of Highways is required to operate a toll bridge or ferry. Each ferry company must, where it is practicable, maintain a dock at each landing. The construction of docks, aprons, and moorings is regulated. A Kentucky corporation constructing, maintaining and operating a bridge across a Kentucky boundary stream or river may consolidate with a similar corporation of an adjoining state. The consolidated corporation can construct, maintain and operate the bridge and condemn the necessary land. The county courts have jurisdiction to establish ferries and grant ferry privileges upon any navigable water in or adjoining the county and to regulate, control

and revoke the same. Condemnation of land for ferry purposes is regulated. The ferry owner or lessee of any ferry operated for compensation must grade and pave the banks of the stream where a road or public highway not maintained by the state crosses the stream. Upon the approval of the United States Chief of Engineers and the Secretary of War, any person may build a bridge over navigable Kentucky waters. The powers of corporation operating a bridge in Kentucky include maintenance and operation of the bridge and collection of reasonable tolls for the use of such bridge. (Powell-Florida)
W70-05460

OBSTRUCTION OF WATERCOURSES; DESTRUCTION OF BRIDGES, MILLDAMS, LEVEES, AND DITCHES; TAKING FISH FROM PRIVATE POND.

Mo Ann Stat secs 560.525, 560.540, 560.545, 560.560, 560.565 (1953).

Descriptors: *Missouri, *Structures, *Obstruction to flow, *Fishing, Legislation, Bridges, Mill dams, Dikes, Levees, Water utilization, Riprap, Ponds, Fish conservation, River regulation, Ditches, Legal aspects, Channel improvement.
Identifiers: Penalties (Criminal).

The willful and malicious damage to or destruction of any bridge, milldam, hydraulic power or reservoir dam, levee, or any supporting structure is prohibited. The willful and malicious injury, destruction, or obstruction of any ditch or levee constructed pursuant to state law is a misdemeanor. It is misdemeanor to obstruct any watercourse by blocking it with brush, logs, or trees. Good-faith riprapping of stream banks, lawful straightening of watercourses, and rafting or logging operations are expected. Anyone entering lands for the purpose of taking fish from any private pond without the consent of the owner commits a misdemeanor. (Caldwell-Florida)
W70-05463

ST LAWRENCE SHORES, INC V STATE (CONDEMNATION OF CREEK OWNED BY PLAINTIFF).

302 NYS2d 606-615 (Ct Cl 1969).

Descriptors: *New York, *Eminent domain, *Ownership of beds, *Navigable rivers, Riparian rights, Navigable waters, Streambeds, Right-of-way, Reasonable use, Damages, Easements, Access routes, Rivers, Riparian land, Severance, Public rights, Banks, Judicial decisions, Land tenure, Water rights, Non-consumptive use, State governments.

The state condemned all of that portion of a creek owned by plaintiff landowner to build a bridge. Plaintiff claimed, among his items of damage, that the phrase 'fee without access' used in describing the state's title to the land in question deprived him of the right of access between his upstream lands and the river into which the creek flowed. The court held that as the state may, like any other landowner, own the streambed, it does not own the water which courses through the stream and has no right to deprive the public of the right to use the navigable creek. 'Fee without access' referred only to the space which the bridge itself occupied and did not deny plaintiff the use of the creek. Therefore, since the plaintiff was not denied access to his upstream property via the creek, he was not entitled to an award for damages. (Caldwell-Florida)
W70-05516

6F. Nonstructural Alternatives

FLOOD WARNING AND COMMUNITY ACTION.
Nebraska Soil and Water Conservation Commission, Lincoln.

Nebraska State Water Plan Publication No 403, August 1969. 15 p, 3 fig, 18 photo.

Descriptors: *Floods, *Nebraska, *Non-structural alternatives, Planning, Flood forecasting, Water management (Applied), Zoning, Flood damage, Legislation.
Identifiers: *Flood warning.

Floods in Nebraska cause an average accountable loss to the economy of over $20,000,000 each year. It is estimated that the total loss due to floods in Nebraska is nearly $40,000,000 per year. The cost of many steps toward reduction of flood damages is insignificant compared to the damage caused by even minor floods. Specific actions are suggested which would help achieve a reduction of flood losses. This Recommendation, a part of the State Water Plan requested by Legislative Resolution No. 5 of the regular 1967 Session, deals with the opportunity to reduce flood losses by advance planning for prompt, effective flood warnings and responsive community action. The present organization for emergency action is evaluated and improvements are proposed. (Knapp-USGS)
W70-05175

WISE USE OF FLOOD PLAINS.
New England River Basins Commission, Boston, Mass.

New England River Basins Commission Interim Report, July 1969. 35 p, 4 fig, append.

Descriptors: *Non-structural alternatives, *Flood plain zoning, *Water management (Applied), *New England, Land use, Planning, Water policy, Water resources development, Recreation, Scenery, Zoning.
Identifiers: Flood plain management.

Flood plain development and the use of non-structural alternatives in New England are reviewed. In many cases, structural measures are not feasible, economically justified, or politically acceptable. The alternative is non-structural measures or Flood Plain Management. Flood plains often have high-value uses other than commercial, residential, industrial or public development, all of which are subject to flood damage. Valley storage acts as a natural reservoir, reducing downstream flood damage. Flood plains are of value for a variety of outdoor recreation activities, are highly scenic, and provide ribbons of green and open space in both rural and urban areas. Wetlands constitute critical fish and wildlife habitat, often to the degree that their preservation is fully justified for these purposes quite apart from flood damages. An inventory was made of existing programs and policies at all levels of government as related to flood plains, wetlands and open spaces. (Knapp-USGS)
W70-05177

FLOOD PREVENTION AND DAMAGE REDUCTION.
Nebraska Soil and Water Conservation Commission, Lincoln.

Nebraska State Water Plan Publication No 401, July 1968 (revised). 19 p, 1 fig, 26 photo.

Descriptors: *Flood protection, *Nebraska, *Non-structural alternatives, Flood plain zoning, Regulation, Building codes, Planning, Legislation, Economics, Flood damage, Flood forecasting.
Identifiers: Flood prevention.

Recommendations for flood control and damage reduction for inclusion in Nebraska's State Water Plan are presented. Techniques recommended include land regulation, zoning, floodways, and various structures. The main emphasis is on regulation of land use and other non-structural alternatives. The economics and social aspects of the various methods are briefly discussed. A list of recommendations for action is presented for consideration by the Governor and the Legislature. (Knapp-USGS)
W70-05187

THE QUALITY OF THE ENVIRONMENT: A REVIEW,
Toronto Univ. (Ontario). Dept of Geography.
Ian Burton.
The Geographical Review, Vol 58, No 3, p 472-481, 1968. 39 ref.

Descriptors: *Environmental sanitation, Ecosystems, Cost-benefit analysis, Pollution abatement, Legislation, Social aspects, Political aspects, Economic feasibility, Reviews.
Identifiers: Quality of living, Individual rights, Fundamental issues.

The Environmental Pollution Panel of the President's Science Advisory Committee says the public should recognize the right of the individual to the absence of environmental pollution but fails to suggest solutions for securing such rights. Political and legislative action has been ahead of knowledge and understanding, although behind public opinion, which continues to be stimulated by forebodings and conservationists' cries. Morally and ideologically neutral research is the basis for good politics. Herfindahl and Kneese (See W69-07180) state that desires must be balanced against costs and assume that the economic evaluation would be the road to progress. Turvey rejects technical economic calculation for legal and institutional means: regulating or taxing where externalities exist (a smoky factory) or internalizing side effects (merge upstream sanitary authority with downstream water-supply authority). Legal solutions are costly and time consuming, thus technical solutions are sought, which may create greater problems in the future. Homo sapiens (particularly the native of an environment) is adaptive to the point of accepting the worst of environments, says Sonnenfeld. As travel and migration increase the proportion of immigrants' demands for environmental quality rises. (Powers-Wisconsin)
W70-05373

6G. Ecologic Impact of Water Development

WATER, EARTH AND MAN.

Richard J. Chorley, editor. London, Methuen and Co, 1969. 588 p.

Descriptors: *Water resources, *Hydrology, *Hydrogeology, *Social aspects, *Economics, Water resources development, Geomorphology, Surveys, Reviews, Ecology, Environment, Urbanization, Human resources, Natural resources.
Identifiers: Economic geography, Georgraphy, Social geography.

The theme of this book is that the study of water provides a logical link between an understanding of physical and social environments. Each chapter develops this theme by proceeding from the many aspects of water occurrence to a deeper understanding of natural environments and their fusion with the activities of man in society. In this way water is viewed as a highly variable and mobile resource in the widest sense. Not only is it a commodity which is directly used by man but it is often the mainspring for extensive economic development, commonly an essential element in man's aesthetic experience, and always a major formative factor of the physical and biological environment which provides the stage for his activities. (Knapp-USGS)
W70-05173

THE STRATEGY OF ECOSYSTEM DEVELOPMENT,
Georgia Univ., Athens.
Eugene P. Odum.
Science, Vol. 164, 18 April 1969, p. 262-270, 2 fig, 2 tab, 38 ref.

Descriptors: *Ecosystems, Ecology, Succession.
Identifiers: *Metropolitan water resources management, *Ecosystem development, Ecological succession, Homeostasis.

The principles of ecological succession bears importantly on the relationships between man and nature. The framework of successional theory needs to be examined as a basis for resolving man's present environmental crisis, including metropolitan water resource management. A tabular model of ecological succession is presented indicating the trend to be expected in the development of ecosystems. The change in ecosystem attributes from developmental stages to mature stages is outlined. Among the groups of ecosystem attributes considered are community energetics, community structure, life history, nutrient cycling, selection pressure, and overall homeostasis. Contrasting characteristics of young and mature type ecosystems are discussed; young ecosystems are characterized by production, growth, and quantity; mature ecosystems by protection, stability. More emphasis needs to be placed on compartmentalization, so that growth-type, steady-state, and intermediate-type ecosystems can be linked with urban and industrial areas for mutual benefit. A compartment model of the basic kinds of environment required by man, partitioned according to ecosystem development and life-cycle resource criteria is described. Four main components are described: the protective environment (mature systems), the productive environment (growth systems), the compromise environment (multiple-use systems), and the urban-industrial environment (non-vital systems). (Davis-Chicago)
W70-05442

THE ROLE OF MAN IN ESTUARINE PROCESSES,
Maryland Univ., Solomons. Natural Resources Inst.
For primary bibliographic entry see Field 05B.
W70-05539

07. RESOURCES DATA

7A. Network Design

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
R. W. Carter, and M. A. Benson.
Geological Survey Open-file report, November 25, 1969. 33 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Data collections, *Streamflow, *Hydrologic data, *Network design, *Systems analysis, Planning, Statistical methods, Statistics, Model studies, Surface waters.
Identifiers: Data requirements.

The principal elements in surface water data program planning are (1) establishing the objective and goals of the program, (2) examining and analyzing all available data to determine which of the goals have already been met, (3) considering alternate means of meeting the remaining goals, and (4) identifying elements that should be included in the future program. The framework for program design is related to four classifications of data which are: data for current use, data for planning and design, data for definition of long-term trends, and data on stream environment. Accuracy equivalent to 25 years of record is specified for principal streams (over 500 square miles), and an accuracy equivalent to 10 years of record is specified for minor streams. A systems approach to definition of flow characteristics is required for regulated streams. An analysis of all available data helps provide the basis for design of the streamflow data program. (Knapp-USGS)
W70-05073

EVALUATION OF WATER-QUALITY MONITORING IN THE ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Joe A. Moreland, and John A. Singer.
Geological Survey Open-file report, 1969. 27 p, 5 fig, 3 tab, 12 ref.

Descriptors: *Water quality, *Monitoring, *Groundwater, *California, *Observation wells, Networks, Data collections, Water analysis, Saline water intrusion, Water pollution sources, Path of pollutants, Irrigation water, Municipal water.
Identifiers: Orange County (Calif).

Water samples for chemical analysis are collected periodically from 272 wells in the Orange County, California Water District by 16 agencies. Many other wells are sampled at infrequent intervals by these and other agencies. The efficiency and completeness of the entire network are evaluated, and changes in standards for the network are suggested. Complete chemical analysis of a water sample is not always necessary. Selective analyses suggested for obtaining specific types of data include: (1) Chloride determination and electrical conductivity measurements on samples from aquifers susceptible to intrusion of sea water; (2) sulfate, bicarbonate, and nitrate determinations on samples from aquifers underlying the forebay area; and (3) sodium, sulfate, chloride, and boron determinations and electrical conductivity measurements on samples from aquifers used as a source of irrigation water. (Knapp-USGS)
W70-05170

7B. Data Acquisition

STRATIFIED RESERVOIR CURRENTS: PART II, THE NUMAC METHOD FOR NON-HOMOGENEOUS UNCONFINED MARKER-AND-CELL CALCULATIONS,
Oregon State Univ., Corvallis. Engineering Experiment Station.
For primary bibliographic entry see Field 02E.
W70-05049

INTEGRATING-FLOAT MEASUREMENTS AT LOW VELOCITIES,
Missouri Univ., Columbia. Dept. of Civil Engineering; and Tennessee Valley Authority, Norris. Hydrology Lab.
Henry Liu, and Larry D. Martin.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7027, p 143-151, January 1970. 9 p, 1 fig, 1 tab, 7 ref, append. OWRR Project A-006-MO.

Descriptors: *Current meters, *Stream gages, *Flow measurement, Instrumentation, Open channel flow, Discharge (Water), Velocity, Floats.
Identifiers: Float gages.

Flow measurement by the integrating-float method was tested in a rectangular flume 1 ft wide and 2 ft deep. Stainless steel hollow spheres, 5/8-in. diam, were used as floats. Accuracy of the technique was evaluated by comparing discharges measured with floats to those measured with standard weirs. For flows in the velocity range tested (between 0.02 and 0.3 fps), the average error for 40 runs was less than 2.5%, and there was no tendency for increase in error as velocity decreased. (Knapp-USGS)
W70-05066

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

A VOLUMETRIC RESPIROMETER FOR STUDIES OF AERIAL AND AQUATIC OXYGEN CONSUMPTION,
Royal Univ. of Malta, Valletta. Marine Biology Research Group.
J. V. Bannister, W. H. Bannister, and H. Micallef.
Oikos, Vol 20, No 2, p 534-536, 1969. 3 fig, 4 ref.

Descriptors: *Instrumentation, Oxygen, Respiration.
Identifiers: Micro-dosimeter, Respirometer, Fluid-driven magnetic stirrer, Aquatic oxygen consumption, Aerial oxygen consumption.

The constructional and operational details of a volumetric plastic respirometer are described. The respirometer embodies a submersible fluid-driven magnetic stirrer to equilibrate water with the gas phase when measurements of aquatic respiration are made, and a micro-dosimeter which gives direct readings of oxygen consumption which may be reset to the zero mark after each reading. (Haskins-Wisconsin)
W70-05089

SIMPLE STREAM TANK SIMULATING A RAPIDS ENVIRONMENT,
Manitoba Univ., Winnipeg. Dept. of Zoology.
J. H. Gee, and V. G. Bartnik.
Journal Fisheries Research Board of Canada, Vol 26, No 8, p 2227-2230, 1969. 1 fig, 7 ref.

Descriptors: *Simulation analysis, *Model studies, *Fish, Streamflow, Hydraulic models, Measurement, Spawning.
Identifiers: Cyprinidae, Rhinichthys, Aquarium, Prespawning, Stream tank, Rapids environment.

The construction of a simple and inexpensive stream tank is described. A false bottom, capable of supporting gravel to a depth of 10 centimeters, is suspended across the width of the aquarium, providing a rapids environment of 0.6 square meters with a slope of 1 centimeter rise per 12 centimeter length. Circulation on a vertical plane is provided by compressed air (12-15 psi) available at four outlets at one end of the aquarium. Water lifted by the compressed air is deflected off a glass plate and passed over and along the false bottom. Flow over the plate can be varied between 0.014 and 0.50 meters/second depending on the number of outlets open. Stainless steel screens running across the width of the aquarium at either end of the false bottom retain the fish and enable food items to be recirculated over the bottom and constantly available to the fish. Two of these stream tanks were used to investigate and compare the prespawning and spawning behavior of two species of dace (Cyprinidae: Rhinichthys). (Haskins-Wisconsin)
W70-05096

HOT-FILM TURBULENCE MEASUREMENTS IN WATER FLOW,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
Francois J. Resch.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7177, p 787-800, March 1970. 14 p, 14 fig, 16 ref, append.

Descriptors: *Turbulence, *Turbulent flow, *Current meters, Instrumentation, Water measurement, Velocity, Vortices.
Identifiers: Hot-film anemometers, Turbulence meters.

Turbulence measurements in water may be made using hot-film anemometers. Two special types of hot-film probes were tried: (1) wedge-shaped probes which must take into account a drift of the characteristics which can be corrected experimentally; and (2) conically shaped probes which do not present the disadvantage of drift. A study of the heat transfer between probe and water led to the establishment of a non-dimensional relationship. Measurements of relative intensities and energy spectra were carried out and compared with those

of previous authors in air and for dynamically similar flows. Hot-film anemometry methods can be used, under controlled conditions, for turbulence measurements in water with the same degree of accuracy as found for measurements in air. (Knapp-USGS)
W70-05128

INTEGRATING-FLOAT MEASUREMENTS IN TURBULENT FLOWS,
Missouri Univ., Columbia. Dept. of Civil Engineering, and Public Health Service, Columbia, Mo.
Henry Liu, and Charles D. Morris.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7101, p 565-572, February 1970. 8 p, 1 fig, 1 tab, 5 ref, append.

Descriptors: *Flow measurement, *Floats, *Turbulent flow, *Hydraulic models, *Stream gages, Dispersion, Hydrology, Open channel flow, Turbulence, Current meters.
Identifiers: Integrating-float current meters.

The effect of turbulence on discharges measured by the integrating-float method is studied. Based on Taylor's classical theory on diffusion of fluid particles by continuous movements, an equation is derived giving the dispersion of floats in a homogeneous turbulence field. It shows that larger errors are expected in using the float technique when the relative intensity and scale of turbulence are large, and when the float used rises rapidly. In the experimental part of the study, the integrating-float technique was used to measure discharges in a laboratory flume. A grid was sometimes placed in the flume to decrease turbulence scale and intensity. Results obtained are weir. For a total of 16 runs taken in flows with turbulence of various intensities and scales, the average errors based on 18 releases are 1% for cases with grid and 3% for cases without grid. (Knapp-USGS)
W70-05140

LINEAR PROPORTIONAL WEIRS,
Regional Engineering Coll., Rourkela (India). Dept. of Civil Engineering.
P. Sreenivasulu, and R. Raghavendran.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7062, p 379-389, February 1970. 11 p, 8 fig, 2 tab, 9 ref, append.

Descriptors: *Stage-discharge relations, *Weirs, *Flow measurement, Instrumentation, Model studies, Hydraulic models, Stream gages.
Identifiers: Parabolic weirs.

The profile equation of weirs with parabolic bottoms is analytically obtained for the condition of discharge varying linearly with head. The result has the form of an integral equation of the Abel type. The solution is obtained in a simple form. Experiments were conducted on a weir plate at the end of a rectangular channel 5.2 m long, 40 cm wide, and 62 cm deep. The experimantal results confirm the linearity existing between the discharge and the head, which is measured above an analytically fixed datum line. A table shows coordinates of the profile in a convenient nondimensional form. The variation of the coefficient of discharge and its recommended value are described. (Knapp-USGS)
W70-05146

DEPTH-INTEGRATING AND DIP SAMPLERS,
Agricultural Research Service, Riesel, Tex. Southern Plains Branch.
Walter G. Knisel, Jr., and Ralph W. Baird.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7084, p 497-507, February 1970. 11 p, 9 fig, 1 tab, 13 ref, append.

Descriptors: *Suspended load, *Sampling, *Measurement, Instrumentation, Reliability, Statistical methods, Hydraulics, Sedimentation, Sedimentology.
Identifiers: Suspended load samplers.

Comparative tests of depth-integrating and dip samplers were made for fine-grained suspended sediment. Approximately 60% of the suspended load was 2 microns and smaller in size. Differences between suspended-sediment concentrations obtained with dip samplers and depth-integrated samplers were statistically significant. Concentrations of depth-integrated samples averaged 1.02% greater than concentrations of dip samples. (Knapp-USGS)
W70-05149

TECHNIQUES FOR THE TRACING OF SUBTERRANEAN DRAINAGE,
For primary bibliographic entry see Field 02F.
W70-05166

AN EVALUATION OF RADAR IMAGERY AS A TOOL FOR DRAINAGE BASIN ANALYSIS,
Kansas Univ., Lawrence. Dept. of Geography.
Roger M. McCoy.
PhD Thesis, Kansas University, 1967. Reproduced by University Microfilms, Ann Arbor, Mich, 1968. 102 p, 37 fig, 12 tab, 57 ref. NASA Contract 17-004-003, NASA Grant NsG-298.

Descriptors: *Remote sensing, *Terrain analysis, *Radar, *Drainage patterns (Geologic), Topography, Geomorphology, Drainage density, Tributaries, Surveys, Mapping, Instrumentation.
Identifiers: Drainage basin analysis, Stream length, Stream order, Bifurcation ratio.

Radar images offer an untested, but highly promising, tool for drainage basin analysis. The large coverage and the abundance of landform detail make radar especially suited for areal reconnaissance studies. An analysis was made of drainage basins on a K-band radar imaging system, and two other radar systems were used for comparison. Each of the basins selected on radar imagery was also examined on USGS 7-1/2 minute topographic quadrangles. The same methods of stream ordering, counting, measuring, and data handling were applied to map and radar drainage displays. Preliminary analysis of drainage basins on AN/APQ-69 and a synthetic aperture radar shows that first and second-order streams may be missing entirely on those systems. The K-band radar imagery, however, shows a substantial number of first-order streams, and a correlation and regression analysis was used to determine the actual relationship between radar data and topographic map data. Drainage area, basin perimeter, bifurcation ratio, average length ratio and circularity ratio can be measured from the imagery with little difference from the map derived values. Terrain slope can be derived from measurements of slope lengths and depression angles using two different radar views of the same slope. (Knapp-USGS)
W70-05180

FIELD METHODS OF WATER HARDNESS DETERMINATION,
Ian Douglas.
British Geomorphological Research Group Technical Bulletin No 1, 1968. 35 p, 2 fig, 6 tab, 83 ref.

Descriptors: *Water chemistry, *Hardness (Water), *Water analysis, Analytical techniques, On-site tests, On-site investigations, Karst, Limestones, On-site laboratories, Sampling.
Identifiers: Karst hydrology.

Tablet methods can give resonably accurate determinations of water hardness. Their simplicity, compactness and cheapness makes them particularly suitable for reconnaissance field investigations, and for use by cave exploration parties who make available so much of the basic data which is used by karst morphologists. These tablet methods should be regarded not as a replacement for laboratory determinations, but as a means of extending the amount of data available on karst water quality. The possibility of field measurements of pH, temperature, spring or river discharge and hardness makes reconnaissance observations of karst processes feasible, and should increase the scientific value of many expeditions to remote areas. An annotated bibliography of field testing procedures, laboratory analytical methods, and karst hydrogeochemistry is included. (Knapp-USGS)
W70-05183

EARTHQUAKE PREDICTION AND CONTROL,
Geological Survey, Menlo Park, Calif.
L. C. Pakiser, J. P. Eaton, and J. H. Healy.
Science, Vol 166, No 3912, p 1467-1474, Dec, 1969. 8 p, 11 fig, 31 ref.

Descriptors: *Earthquakes, Faults (Geology), Geologic investigations, Geology, Geophysics, Underground explosions, Reservoirs, California, Nuclear explosions, Injection wells, Impounded waters, Seismic investigations, Hazards, Safety, Seismology, Seismic studies, Disasters, Bibliographies.
Identifiers: Earthquake theory, Earthquake zones, *Earthquake forecasting, *Earthquake control, Earthquake warning systems.

Studies of natural and man-made earthquakes are providing knowledge on earthquake characteristics and are offering some prospects for successful prediction and perhaps eventual control. Earthquake activity is discussed, particularly investigations of the San Andreas fault zone in California and observations of seismic activity associated with filling reservoirs, subsurface fluid injection, and underground nuclear explosions. Combined leveling and geodimeter surveying accompanied by continuous monitoring of seismic activity offers a basis for a long-range earthquake-warning system. Short-range prediction of earthquakes may be achieved by continuous monitoring of ground tilt, strain, seismic activity, and possibly fluctuations in the earth's magnetic field. Studies of man-made earthquakes indicate the possibility of developing a practical method of dislodging locked sections of a major fault, thereby releasing the accumulated strain energy and inhibiting the development of a disastrous earthquake. (USBR)
W70-05218

SEISMIC WAVE VELOCITY AS A MEANS OF IN-PLACE DENSITY MEASUREMENT, FINAL REPORT - PART 1 OF 2,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 08D.
W70-05247

GRANULOMETER--A SEDIMENT ANALYZER DIRECTLY WRITING GRAIN SIZE DISTRIBUTION CURVES,
Central Geological Inst., Prague (Czechoslovakia).
Jiri Brezina.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1627-1631, 1969. 2 fig, 12 ref.

Descriptors: *Sediments, *Statistical methods, Analytical techniques, Suspension, Electronic equipment, Distribution (Curves).
Identifiers: *Sediment analysis, *Granulometer, Settling particles, Corey's shape, Grain size, Modified settling tubes, Thermo-variomatic control, Transducer.

The name 'granulometer' was applied to a modification of the Woods Hole Rapid Sediment Analyzer. The modification eliminates the need for temperature stabilization and can plot grain size distribution curves up to 250 samples per day. Results are well adapted for statistical analyses by computer. (Wilde-Wisconsin)
W70-05268

DESIGN FEATURES OF INTACT LEAF THERMOCOUPLE PSYCHROMETERS FOR MEASURING WATER POTENTIAL,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.;

Agricultural Research Service, Riverside, Calif. Salinity Lab.; and Army Electronics Command, Fort Huachuca, Ariz. Research Div.
For primary bibliographic entry see Field 02I.
W70-05294

UNDERWATER LASER SURVEYING SYSTEM,
TRW Systems Group, Redondo Beach, Calif.
Donald R. Borchardt.
Available from the Clearinghouse as AD-859 968, $3.00 in paper copy, $0.65 in microfiche. Final Report 21, NCEL-CR-69.028, 12 Mar 69, 131 p. Contract N62399-69-C-0010 for the Naval Facilities Engineering Command.

Descriptors: *Surveying instruments, Mapping, Hydrography, *Oceanography.
Identifiers: Tekite project, Underwater laser surveying, Gas lasers, Ocean bottom topography.

The report describes the development of an Underwater Laser Surveying System usable by two divers for plot layout, bottom contour mapping and other underwater surveying missions. The portable cold-cathode argon laser is the central element to the system. The supporting test program demonstrated the feasibility of the system for plot layouts to 6 inch accuracy and contour elevation to 1.2 inch accuracy oer ranges of up to 100 feet. Operating procedures and maintenance instructions for the system are also included.
W70-05318

THE RELATIONSHIP OF FRESH-WATER PROTOZOAN COMMUNITIES TO THE MACARTHUR-WILSON EQUILIBRIUM MODEL,
Virginia Polytechnic Inst., Blacksburg. Dept. of Biology; Virginia Polytechnic Inst., Blacksburg. Dept of Forestry and Wildlife; and Michigan Univ., Ann Arbor. Dept. of Botany.
John Cairns, Jr., M. L. Dahlberg, Kenneth L. Dickson, Nancy Smith, and William T. Waller.
The American Naturalist, Vol 103, No 933, p 439-454, 1969. 5 fig, 3 tab, 28 ref.

Descriptors: *Model studies, *Protozoa, *Methodology, Invasion, Population, Environmental effects, Succession, Dominant organisms, Biological communities, Equilibrium.
Identifiers: *MacArthur-Wilson model, *Colonization rates, Extinction rates, Douglas Lake (Mich).

The colonization rate of protozoa on artificial substrates fits a simple exponential curve. In early stages of invasion, colonization rate greatly exceeded extinction rate; colonization and extinction rates approached but did not reach equilibrium as the number of species increased. The extinction rate of protozoa species did not follow the simple exponential curve as suggested by the MacArthur-Wilson equilibrium model. Results suggest occurrence of favorable interactions between protozoan species. Numbers of individuals per species increased following initial colonization period; this was followed by a secondary increase in specie numbers. It is suggested that secondary increase in number of species was due to microenvironmental changes induced by already-established protozoa. Results indicate that formation and composition of protozoan communities on artificial substrates are the result of interactions comparable to those proposed in the MacArthur-Wilson model. (Voightlander-Wisconsin)
W70-05374

A NEW MIDWATER TRAWL FOR SAMPLING DISCRETE DEPTH HORIZONS,
National Inst. of Oceanography, Wormley (England).
Malcolm R. Clarke.
Journal of the Marine Biological Association of the United Kingdon, Vol 49, No 4, p 945-960, 1969. 8 fig, 16 ref, 2 plates, append.

Descriptors: *Instrumentation, *Sampling, Measurement, Depth, Vertical migration, Fish, Crustaceans, Mollusks, Aquatic animals.
Identifiers: *Vertical distribution, Midwater trawl, Micronekton, Acoustic release gear, Depth telemetering pinger.

To facilitate studies of vertical distribution of water-inhabiting animals, a modification of the Tucker's trawl was designed. To regulate the sampling of micronekton, including fish, decapodes, and cephalopods, the trawl is provided with opening and closing device, acoustic release gear, and depth telemetering pinger. The net and release gear were developed for use from RRS Discovery for recording vertical migration of particular size animals. However, modifications of the basic design for use on other ships do not present difficulties. (Wilde-Wisconsin)
W70-05376

AIRBORNE FLUOROMETER APPLICABLE TO MARINE AND ESTUARINE STUDIES,
Geological Survey, Washington, D.C.; and Perkin-Elmer Corp., Norwalk, Conn.
George E. Stoertz, William R. Hemphill, and David A. Markle.
Marine Technology Society Journal, Vol 3, No 6, p 11-26, 1969. 24 fig, 16 ref.

Descriptors: *Instrumentation, *Sampling, *Measurement, *Fluorometry, Dye releases, Currents (Water), Remote sensing, Sea water, Chlorophyll, Oil, Algae, Pacific Ocean.
Identifiers: *Fraunhofer line discriminator, Rhodamine WT dye, Airborne tests, Oil spills, Geological SS Polaris, Chlorophyll fluorescence, Fabry-Perot filters, Solar Fraunhofer lines, Attenuation measurement apparatus, Hydrogen F line.

This study was concerned with performance and possible improvements of the Fraunhofer line discriminator (FLD). This fluorometer is the first to provide direct measurements of fluorescence in broad daylight and from a remote platform, thus greatly facilitating studies of current flow and rate of dispersion of rhodamine and other tagging dyes. The smallest detectable increment of rhodamine wt in 0.5 meter depth was 1 ppb. Temperature significantly influenced the FLD results. Shipboard and helicopter tests of the FLD and plotting of flight paths by tracking radar were successful. The dye was detectable in airborne tests at altitudes exceeding 5000 feet. A new design having only one photomultiplier should eliminate the need for monitoring standard targets. Additional improvements may enable detection of chlorophyll fluorescence, oil spills or leakages, algal blooms and indication of pollution, and facilitate dispersion studies. (Wilde-Wisconsin)
W70-05377

AN ANALYSIS OF MARINE CORER DYNAMICS,
Navy Underwater Sound Lab., New London, Conn.
Kirk T. Patton, and Gary T. Griffin.
Marine Technology Society Journal, Vol 3, p 27-40, 1969. 11 fig, 1 tab, 7 ref, appendix.

Descriptors: *Cores, *Mathematical models, *Computer programs, Sediments, Sedimentary structures, Kinetics.
Identifiers: Marine cores, Core distortion, Corer dynamics, Navy Underwater Sound Laboratory.

A mathematical model and computing program were developed to resolve questions pertinent to the maximum penetration of corers, pipe buckling, and distortion of the core sample. The model is used to compute the kinetic energy of the corer just prior to its impact into the sediment. The program is terminated when kinetic and potential energy have been dissipated by friction forces. The program is applicable to all types of designs except piston corers. Investigations of the influence of corers' size, cutter angle, cutter size, and other parameters illustrate the versalitity of this program. (Wilde-Wisconsin)
W70-05378

SAMPLING RESERVOIR FISH POPULATIONS USING MIDWATER TRAWLS,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark. South Central Reservoir Investigations.
For primary bibliographic entry see Field 02H.
W70-05382

ENUMERATION OF FRESHWATER PHYTOPLANKTON CONCENTRATED ON THE MEMBRANE FILTER,
Wisconsin Univ., Madison. Dept. of Botany.
Clarence D. McNabb.
Limnology and Oceanography, Vol 5, No 1, p 57-61, 1960. 4 tab, 16 ref.

Descriptors: *Analytical techniques, *Microscopy, *Phytoplankton, Estimating, Distribution, Evaluation.
Identifiers: *Membrane filters, *Plankton counts, Quadrat scoring, Random distribution count.

Both haemacytometer and Sedgewick-Rafter counting chambers are of such thickness that nannoplankton, observed best under higher magnification, may be underestimated. A membrane filter technique is described which offers complete plankton counts at any magnification desired. Other advantages over conventional methods are described. The sample is 'fixed' (4% of a 40% formaldehyde solution) and passed through an HA Millipore filter which is then placed on a glass slide and 'cleared' with immersion oil for 24 hours. A coverslip may be placed in the cleared slide before microscopic observation. The percentage of fields in which a species occurs is validly converted to a theoretical average number of individuals per field. The theoretical density obtained and the actual density determined by time-consuming counting are nearly similar values when 25 or more fields are scored. (Gerhold-Wisconsin)
W70-05388

CHEMILUMINESCENT METHOD FOR DETECTING MICROORGANISMS IN WATER,
St. John's Univ., Jamaica, N.Y. Dept. of Biology.
For primary bibliographic entry see Field 05A.
W70-05391

THE TURNOVER RATIO IN PRODUCTION ECOLOGY OF FRESHWATER INVERTEBRATES,
Minnesota Univ., St Paul. Dept. of Entomology, Fisheries, and Wildlife.
Thomas F. Waters.
The American Naturalist, Vol 103, No 930, 1969. 6 fig, 5 tab, 18 ref.

Descriptors: *Invertebrates, *Methodology, *Productivity, *Secondary productivity, *Measurement, Data collections, Evaluation, Growth stages, Benthic fauna, Aquatic insects, Crustaceans.
Identifiers: *Turnover ratio, Allen curves.

Turnover ratios, defined as the ratio of a cohort's production to the mean standing crop determined during the life of that cohort, are examined for their possible utility in estimating rates of production. Most turnover ratios for benthic invertebrates vary from 2.5 to 5, having a mode of about 3.5. Turnover ratios computed from families of growth-survivorship curves (Allen curves), assuming most probable conditions, varied from three to four for aquatic insects and somewhat higher for crustaceans. Relative size of final population appears to have greatest effect on shape of Allen curve and hence could affect estimate of turnover ratio. Production estimates based on a turnover ratio assumed from Allen curves would be limited to discrete cohorts. Use of annual turnover ratios

for entire benthic fauna is suggested; this method must await additional empirical information on life cycles of benthic forms. Turnover ratios obtained as equal to life-cycle instantaneous growth rates were similar to those obtained from Allen curves, but averaged about one unit larger. Graphical and tabular data include types of curves considered and calculated turnover ratios. (Voigtlander-Wisconsin)
W70-05396

A HYDRAULIC CORER FOR USE IN WATER SATURATED SEDIMENT,
Massachusetts Univ., Amherst.
John A. Gifford.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1619-1621, 1969. 3 fig, 7 ref.

Descriptors: *Saturated soils, *Sampling, *Cores, Instrumentation, Measurement, Soil density probes.
Identifiers: Hydraulic core sampler.

A simple lightweight suction corer, utilizing expandable plastic core liner, delivers continuous core samples up to 10 feet in length without a loss of sediment's interstitial water. (Wilde-Wisconsin)
W70-05398

A SMALL LABORATORY APPARATUS FOR MEASURING ACCELERATED LOSS RATES OF PESTICIDE DEPOSITS BY 'RAINWASHING',
Rothamsted Experimental Station, Harpenden (England).
F. T. Phillips.
Chemistry and Industry, p 414-415, March 29, 1969. 1 fig, 1 tab, 1 ref.

Descriptors: *Pesticides, Analytical techniques, Evaluation, Measurement, Rain, Gas chromotography, DDT.
Identifiers: Rainwashing, Liquid chromotography, Residual pesticides, LOVO 192.

The devised laboratory apparatus measures the rates at which pesticides are removed from the dry deposits left on surfaces after spraying. A pesticide-sprayed leaf on a plant is exposed to a jet water washing and the liquid is collected at chosen intervals. The pesticide is extracted with hexane or other solvent, and aliquots of extracts are analysed by gas-liquid chromotography (GLC). Pesticide residue is washed with a solvent from the glass accommodating the leaf, the leaf surface is macerated and extracted with the solvent, and the liquids are subjected to GLC analysis. (Wilde-Wisconsin)
W70-05400

PRELIMINARY EVALUATION OF A CORE SCINTILLATION COUNTER FOR BULK DENSITY MEASUREMENT IN MARINE SEDIMENT CORES,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
Chester Brier, Robert Bennin, and Peter A. Rona.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1509-1519, 1969. 4 fig, 5 tab, 15 ref.

Descriptors: *Sediments, *Soil density probes, Cores, Instrumentation, Rocks, Soils, Radioactivity, Density, Measurement.
Identifiers: *Core scintillation counter, Random radiation, Mass attenuation coefficients, Bulk density measurements, Marine sediments.

The bulk density of a sediment is determined by counting radiation that has passed the core sample. The accuracy of results is influenced by random radiation which must be determined by a statistical analysis. The scintillation counts must be additionally corrected by the Compton coefficient which varies significantly with the nature of sediments and content of water. (Wilde-Wisconsin)
W70-05401

POPULATION MODELS AND TEST POPULATIONS AS RESEARCH TOOLS,
Bureau of Commercial Fisheries, Seattle, Wash. Biological Lab.
Ralph P. Silliman.
BioScience, Vol 19, No 6, p 524-528, 1969. 5 fig, 31 ref.

Descriptors: *Population, *Model studies, *Mathematical models, Dynamics programming, Computer models, Mathematical studies, Exploitation, Predation.
Identifiers: *Population models, *Optimum exploitation rate, Population dynamics, Test populations, Maximum attainable yield.

Use of models in our culture is so widespread as to be taken for granted. Such models serve two purposes: to permit experimentation with objects that are smaller and less costly than the full-scale representations, and to save time. There are two distinct modelling approaches to the study of population dynamics: the use of population models, or the utilization of test populations. A population model is a conceptual structure of mathematical of physical elements, while a test population is a small representative sample of the de facto world. Population models have included mechanical, mathematical, and most recently, computer-generated simulation. Test populations of algae, protozoans, bacteria, insects, and fishes have been employed to study such aspects as predator-prey relations and optimum exploitation rates. Most recently, significant findings relating exploitation rate and yield have been made using test populations and analog computer population models. (Huff-Wisconsin)
W70-05414

MODELS FOR DESCRIBING EXCHANGES WITHIN ECOSYSTEMS,
Wisconsin Univ., Madison. Inst. for Environmental Studies.
For primary bibliographic entry see Field 06A.
W70-05420

NONINSTRUMENTAL FACTORS AFFECTING MEASUREMENT OF STATIC WATER LEVELS IN DEEPLY BURIED AQUIFERS AND AQUITARDS, NEVADA TEST SITE,
Geological Survey, Las Vegas, Nev.
Isaac J. Winograd.
Ground Water, Vol 8, No 2, p 19-28, March-April 1970. 10 p, 6 fig, 13 ref.

Descriptors: *Water levels, *Measurement, *Instrumentation, *Hydrogeology, *Nevada, Water table, Aquifers, Transmissivity, Leakage, Aquicludes.
Identifiers: Nevada Test Site.

Accurate measurement of static water levels in wells tapping deeply buried aquifers and aquitards at the Nevada Test Site requires evaluation of and correction for several factors exclusive of instrumentation. Both the drilling method used and the depth of the hole at the time of measurement significantly affect determination of the static water level for the aquitards, and frequently these factors preclude head determination in an economically justifiable time. Density of fluid in the drill stem and hole deviation affect the determination of accurate static water levels for the aquifers. In the principal aquifers, in which hydraulic gradients are as low as 0.5 foot per mile, direct measurement of depth to water is preferable to pressure-gage measurements at the aquifer face. Case histories and graphs are presented to illustrate the magnitude of errors that can result when these factors are disregarded. (Knapp-USGS)
W70-05479

ELECTRIC WELL LOGGING OF HAWAIIAN BASALTIC AQUIFERS,
Hawaii Univ., Honolulu. Dept. of Geosciences; and Honolulu Board of Water Supply, Hawaii.
Frank L. Peterson, and Chester Lao.
Ground Water, Vol 8, No 2, p 11-18, March-April 1970. 8 p, 5 fig, 10 ref.

Descriptors: *Electrical well logging, *Basalts, *Aquifers, *Hawaii, Electrical studies, Surveys, Resistivity, Water wells, Permeability, Porosity, Water yield, Exploration, Borehole geophysics, Investigations.
Identifiers: Basalt aquifers.

An extensive program of electric well logging has been conducted in Hawaii during the past three years. Electric well logging techniques were found to be useful in Hawaiian basaltic aquifers; however, interpretation of both spontaneous potential logs and resistivity logs varies from the conventional interpretation of electric logs in sediments. The interpretation of fluid conductivity logs in Hawaii follows conventional water well techniques. Spontaneous potentials are thought to result primarily from fluid flow rather than from electrochemical potential. Positive SPs generally indicate zones with flow from the aquifers into the well, and negative SPs generally indicate zones with little flow or flow from the well into the aquifer. Resistivity logs indicate the location, number, individual thickness, and total thickness of permeable and less permeable formations, and are useful as indicators of water-yielding zones. High resistivities generally are indicative of dense impermeable basalts and low resistivities are indicative of porous permeable zones most likely to contribute water to the borehole. Both resistivity and spontaneous potential logs provide a direct measurement of depth to water, depth of casing, and depth of hole. (Knapp-USGS)
W70-05480

METHODS AND DEVICES FOR MEASURING CURRENTS,
Marine Advisers, La Jolla, Calif.
Paul L. Horrer.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 80-89, 1967. 10 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Currents (Water), *Current meters, Instrumentation, Estuaries, Runoff, Tidal waters, Stream gages, Ocean waves, Streamflow, Turbulence.
Identifiers: Price meter, Savonius Roter.

The swiftest currents in estuaries are due to tides and to stream runoff. The current, averaged over a period of tens of minutes to several hours, may be measured by tracing and plotting the trajectory of drogues, patches of contaminants or other tracers. Numerous flow-measuring devices have been developed. The cheapest and simplest of these is the captivity drag, which is usable between the surface and depths of 50 to 100 feet. Current meters with rotating elements are in greater use than all other types. The popular ones include the price meter for stream gaging, the modified Roberts, and the modified Savonius rotor with vane; the last two register speed and compass direction and are used by oceanographers. Rotating element meters are subject to error due to wave action, ship roll, and relatively high frequency turbulence. Solid state flowmeters which are capable of measuring turbulence when rigidly fixed at a point in the flow have been developed, but these are relatively costly and somewhat complicated. (Carstea-USGS)
W70-05543

7C. Evaluation, Processing and Publication

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
For primary bibliographic entry see Field 08B.
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-05063

CONCEPTS FOR THE DESIGN OF STREAMFLOW DATA PROGRAMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05073

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER -- PHASE I,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02F.
W70-05116

STORAGE OF FRESH WATER IN UNDERGROUND RESERVOIRS CONTAINING SALINE WATER-PHASE II,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 02F.
W70-05117

ANALOG COMPUTER SIMULATION OF THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-05118

COMPUTER SIMULATION OF THE HYDROLOGIC SYSTEM OF A MOUNTAIN WATERSHED,
Montana Water Resources Research Center, Bozeman.
Darrel E. Dunn.
Available from the Clearinghouse as PB-190 574, $3.00 in paper copy, $0.65 in microfiche. Completion report, Montana Water Resources Research Center, (1970). 52 p. OWRR Project A-025-MONT.

Descriptors: *Basins, *Computer models, Runoff, *Watershed management, *Surface-groundwater relationships.

A digital computer program has been designed to simulate watershed hydrology. The watershed parameter values which must be supplied to the program are all potentially estimable from short term observations made in the watershed. This is a desirable feature not present in other extant models. Input to the model is weather data, and output includes sequential rates of discharge from the various parts of the system, sequential evapotranspiration data, and sequential storage data. The storage requirements of the program do not exceed the number of registers available in modern computer storage units. The amount of computer run-time required and the large amount of input data required limit the application of the model to small watersheds which merit the expenditure of several thousand dollars. The accuracy of the model has not been definitively tested, but the results of the initial runs combined with field investigation of actual watersheds suggest that the transport equations in the program will have to be modified before an acceptable level of accuracy is obtained.
W70-05125

COMPUTATIONAL PROCEDURES FOR FLOW RESISTANCE LAWS,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
Alan A. Smith.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7142, p 665-679, March 1970. 15 p, 9 fig, 1 tab, 5 ref, append.

Descriptors: *Turbulent flow, *Open channel flow, *Closed conduit flow, *Computer programs, *Flow resistance, Equations, Roughness (Hydraulic), Fluid friction, Hydraulics, Discharge (Water).
Identifiers: Flow equations.

The essentially empirical nature of all fluid resistance laws for turbulent flow is stressed. Normal discharge is the only quantity which is always explicitly calculable in channel flow problems. It is suggested that computer programs should not depend on a specific resistance law but should rather be designed to use any one of a number of normal discharge function subroutines which operate on a standard list of parameters. Other quantities implicitly defined in a flow resistance equation, such as depth, energy gradient or roughness, may then be found by iterating on the explicitly determinable normal discharge. The application of such routines is demonstrated with reference to shape effects and experimentally determined friction laws. Flow diagrams of the basic routines are given. (Knapp-USGS)
W70-05127

SURVEY OF PROGRAMS FOR WATER-SURFACE PROFILES,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Bill S. Eichert.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7098, p 547-563, February 1970. 17 p, 5 fig, 1 tab, 23 ref, append.

Descriptors: *Computer programs, *Profiles, *Stage-discharge relations, *Backwater, *Reviews, Surveys, Computers, Digital computers, Hydraulic models, Subcritical flow, Floods.
Identifiers: Water-surface profiles.

Several highly developed computer programs are available for determining water surface profiles for subcritical flow in rivers and channels. The needs for fast, accurate and inexpensive computation of profiles, and for more sophisticated techniques, can be satisfied by computer programs currently being developed. Current capabilities and limitations of computer programs for determining water surface profiles are reviewed. The need to review detailed output because of the complications of manually selecting and describing representative cross sections is stressed. Several current procedures for determining profiles over and through bridges are presented, and the need for more generalized and more accurate methods is cited. Computer program capabilities of the near future in the area of water surface profiles, as well as some current limitations that probably will be surmounted through the additional capabilities of computers, computer languages and advanced engineering techniques such as aerial photography, are analyzed. (Knapp-USGS)
W70-05147

SEEPAGE STUDY USING ELECTRICAL ANALOG,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Technische Universitaet, Berlin (West Germany). Dept. of Water Structure and Water Economy.
For primary bibliographic entry see Field 02G.
W70-05155

REPORT OF THE COMMITTEE ON TERMS AND EQUIVALENTS,
International Council for the Exploration of the Seas, Charlottenlund (Denmark).

Contributions to Plankton Symposium 1957. Measurements of primary production in the sea. Rapports et Proces-Verbaux des Reunions, Vol 144, p 15-16, 1958.

Descriptors: *Primary productivity, *Sea water, *Measurement, Standing crop, Productivity, Biomass, Carbon, Phytoplankton, Chlorophyll, Organic matter, Nitrogen, Zooplankton, Phosphorus, Proteins, Nannoplankton, Diatoms, Bacteria.
Identifiers: *Terms, *Definitions, *Equivalents, Turnover rate, Gross primary production, Displacement volume, Dry plankton, Dry organic matter, Cell volume, Plasma volume, Oxygen equivalent, Fat content, Chitin, Megaloplankton, Macroplankton, Mesoplankton, Microplankton, Ultraplankton, Squids, Salps, Flagellates.

In addition to the contributions to Plankton Symposium of 1957, the Committee on Terms and Equivalents defines measurements of primary production in the sea. The following general terms are defined: standing stock, production, turnover rate, primary productivity, gross primary production. Common definitions are suggested for biomass, displacement volume, settling volume, dry plankton, dry organic matter, cell volume, plasma volume. The following equivalents are recommended as useful for phytoplankton: carbon, dry organic matter, dry plankton, oxygen equivalent, and biomass. Counts of phytoplankton cells should be accompanied with data for conversion to weight or volume. The relationship between chlorophyll and total organic matter is variable and therefore chlorophyll should be used with caution to measure the phytoplankton standing crop; the use of chlorophyll as an indicator of productive capacity is not yet proven. Protein (or nitrogen) should be used prudently because its relationship to total organic matter is variable. The following equivalents are recommended for zooplankton: carbon, nitrogen, phosphorus, protein, dry plankton, biomass, and displacement volume. The plankton are classified according to their size and the characteristics of the species composition are given. (Jones-Wisconsin)
W70-05371

THE COMMUNITY CONCEPT IN MARINE ZOOLOGY, WITH COMMENTS ON CONTINUA AND INSTABILITY IN SOME MARINE COMMUNITIES: A REVIEW,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography.
Eric L. Mills.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1415-1428, 1969. 1 fig, 1 tab, 31 ref.

Descriptors: *Marine animals, *Aquatic life, Reviews, Biota, Dynamics, Publications, Documentation.
Identifiers: *Marine zoology, *Continua, Community concept, Literature review, Dynamic stability, Species constancy, Instability.

The history of the community concept in ecology is long and complex. Controversies regarding this concept have been most common in plant ecology, where the community has been variously regarded as an abstraction based either on a mosaic of vegetation or on independent continuous distributions of species (continua), or as a concrete, quantifiable unit. The analogy between communities and organisms is common, but the analogy must remain loose. Many ideas and terms used by marine ecologists appear to have been borrowed freely and uncritically from plant ecology. The classification of marine biomes is an example of an almost meaningless, overly-simplified synthetic system based on plant ecology. Such usually-accepted community criteria as species constancy and dynamic stability may not have relevance in marine situations. A variety of complex ecological assemblages exist, ranging from loosely integrated aggregations, to continua, to highly stable coadapted groups which are in equilibrium with environmental factors over long periods of time. A community is defined as 'a group of organisms occurring in a particular environment, presumably interacting with each other and with the environment, and separable by means of ecological survey from other groups.' (Voigtlander-Wisconsin)
W70-05393

TECHNICAL SERVICES FOR URBAN FLOOD-PLAIN PROPERTY MANAGERS: PROBLEM FORMULATION AND STUDY OF PROPERTY MANAGER RECEPTIVITY,
Northwestern Univ., Evanston, Ill.
For primary bibliographic entry see Field 04C.
W70-05443

PROGRESS IN DEVELOPING AN INFORMATION SYSTEM TO DISSEMINATE CURRENT WATER RESOURCE SCIENTIFIC INFORMATION,
Water Resources Scientific Information Center, Washington, D.C.
For primary bibliographic entry see Field 10.
W70-05458

COMPUTERIZED SYSTEM FOR WYOMING SURFACE WATER RECORDS,
Wyoming Univ., Laramie. Water Resources Research Inst.
Paul A. Rechard, William N. Embree, and Lee W. Larson.
Available from the Clearinghouse as PB-190 789, $3.00 in paper copy, $0.65 in microfiche. University of Wyoming Water Resources Research Institute Series 13, State Water Plan Report No. 1 - Revised, January 1970. 73 p.

Descriptors: *Computer programs, *Data processing, *Data storage and retrieval, *Streamflow, *Surface waters, Annual discharge, Automation, Duration curves, Frequency analysis, Hydrologic data, Information retrieval, Maximum flow, Mean daily flow, Minimum flow, Water resources, Water year.

A general description of a computerized system for Wyoming Surface Water Records is given. This system, developed by the University of Wyoming's Water Resources Research Institute, in conjunction with the Computer Center, is designed to store and utilize streamflow data. All available programs and types of output are described and procedures for operation of the system are given.
W70-05464

ESTIMATING THE GROUND-WATER CONTRIBUTION TO STORM RUNOFF BY THE ELECTRICAL CONDUCTANCE METHOD,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 02A.
W70-05481

EXPERIMENTAL LARGE-SCALE SNOW AND ICE MAPPING WITH COMPOSITE MINIMUM BRIGHTNESS CHARTS,
National Environmental Satellite Center, Washington, D.C.
E. Paul McClain, and Donald R. Baker.
Environmental Science Services Administration Technical Memorandum NESCTM 12, September 1969. 19 p, 7 fig, 17 ref.

Descriptors: *Remote sensing, *Aerial photography, *Satellites (Artificial), *Data processing, *Mapping, Albedo, Snow, Ice, Clouds, Meteorology, Synoptic analysis, Climatology. Topography, Vegetation.
Identifiers: Brightness charting.

The Composite Minimum Brightness (CMB) chart is a computer product derived from digitized and rectified satellite video data. The minimum brightness values mapped over an area during a given period are composited and displayed as a means of suppressing transient cloudiness and enhancing major snow and ice features in the satellite imagery. Examples are presented, and limitations and verification of the technique are discussed. (Knapp-USGS)
W70-05522

08. ENGINEERING WORKS

8A. Structures

UNSTEADY FLOW OF DILUTE AQUEOUS POLYMER SOLUTIONS IN PIPE NETWORKS-A METHOD TO IMPROVE WATER DISTRIBUTION,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
Henry C. Jackson, and Paul G. Mayer.
Available from the Clearinghouse as PB-190 488, $3.00 in paper copy, $0.65 in microfiche. Jan 1970. Water Resources Center, Georgia Institute of Technology. WRC-0170, January 1970. 134 p, 3 tab, 41 fig, 83 ref, 3 append. OWRR Project A-016-GA.

Descriptors: *Aqueous solution, *Pipe networks, *Polymer additives, *Unsteady flow, *Flow resistance, *Fluid friction, Polymer interfaces, Pipelines, Hydraulic systems, Hydraulic conduits, Flow rates, Water works, Mathematical models.

The purpose of the research was to determine the effect of polymer additives in the flow of water in pipe networks. The use of friction-reducing additives to temporarily improve water distribution systems during emergencies is investigated mathematically and studied experimentally. The research was directed primarily to the prediction of the unsteady flow conditions which result from the injection locally of a long-chain polymer into a pipe network during emergency flow conditions. A computer program is developed to solve the equations associated with the unsteady flow in the network resulting from the additive. The program is used to show that an inadequate existing water distribution system for fire-fighting can be made adequate quickly enough by injection of a friction-reducing long-chain polymer at one point in the system. The report contains 41 illustrations and 83 references. (Conway-Georgia Tech)
W70-05120

TRENDS IN THE DESIGN AND CONSTRUCTION OF DAMS,
R. G. T. Lane, R. Marwick, and P. A. A. Back.
Civ Eng Pub Works Rev, Vol 64, No 760, p 1098-1105, Nov, 1969. 5 p, 7 fig, 6 ref.

Descriptors: *Dams, Damsites, *Dam construction, *Dam design, Rockfill dams, Dam foundations, Earth dams, Concrete dams, Cutoffs, Construction, Methodology, Concrete technology, Embankments, Seismic design, Design, Foundations, Foreign design practices.
Identifiers: *Design improvements, Construction methods, Construction practices, Construction control, Design practices, Great Britain.

Dams have increased in size over the years, and design techniques and construction plant and methods have developed in step. Major trends for earth dams are: (1) construction on deep permeable foundations permitted by development of alluvial grouting techniques and by use of impervious reservoir blankets and pressure relief wells; (2) cutoffs consisting of relatively large trapezoidal trenches backfilled with rolled earthfill or, in soft ground, concrete or clay placed in a narrow trench supported by bentonite slurry; (3) densification of loose permeable foundations by vibroflotation; (4) construction on weak clay foundations by controlling consolidation; and (5) minimizing risk of core cracking by using wider cores, more plastic materials, and compacting wet of optimum. Main developments in embankment construction have been the control of pore pressure, processing of granular material, and use of rockfill in compacted layers. Major trends for concrete dams are: (1) more comprehensive design techniques; (2) more attention to foundation investigation and design; (3) temperature control of concrete; (4) increase in maximum size of aggregate; (5) higher allowable concrete stresses; and (6) precautions against pore pressure buildup in foundations. (USBR)
W70-05225

STRESSES AND DISPLACEMENTS AROUND A CIRCULAR TUNNEL IN A THREE-LAYER MEDIUM-- I AND II,
Columbia Univ., New York.
R. K. Agarwal, and S. H. Boshkov.
Int J Rock Mech Mining Sci, Vol 6, No. 6, p 519-540, Nov 1969. 22 p, 13 fig, 12 tab, 19 ref.

Descriptors: Stress, Strain, Stress analysis, Stress concentration, *Stress distribution, *Displacements, Deformation, Tunnel design, Tunnel pressures, Homogeneity, *Tunnels, Rock mechanics, Elastic theory, Youngs modulus, Computer programs, Bibliographies, Theoretical analysis.
Identifiers: *Finite element method, *Similitude, Plane strain, Stress relaxation, Comparative studies.

The finite element method is used to analyze stress and displacement distributions around a circular tunnel, located in a layer of soft material and surrounded by layers of hard material for different values of the ratio of the height of soft layer to tunnel diameter. Results are compared to available experimental data. For overburden pressure, nonhomogeneity reduced the stress level along the horizontal and vertical axes. High seam pressure may change the magnitude and sign of the stress concentration along the horizontal axis and increase values of stress concentration along the vertical axis. Stress concentration decay rates for homogeneous materials may be different than for layered media. The principle of similitude is applied to stress distributions and displacements around a circular opening located in a continuous linear nonhomogeneous material. Stress distributions and displacements in the linear nonhomogeneous material were significantly different from those in a homogeneous material for identical loading conditions. Stress and displacement fields under the plane stress and plane strain hypotheses were compared for 2 values of the ratio of Young's moduli and differed significantly for high ratios. (USBR)
W70-05232

STRENGTHENING OF JOHN HOLLIS BANKHEAD DAM,
Corps of Engineers, Mobile, Ala.
Frederick G. Thompson.
Civ. Eng, Vol 39, No 12, p 75-78, Dec 1969. 4 p, 2 fig, 2 photo, 1 tab.

Descriptors: *Concrete dams, Corrosion control, *Anchors, Field tests, Grouting, Gravity dams, Rehabilitation, Installation, *Post tensioning, Spillways, Stressing cables, Wire.
Identifiers: *Dam stability, Corrosion tests, Comparative studies, Construction methods, Spillway piers, Anchor cables.

A gated concrete gravity overflow spillway section was strengthened by posttensioned foundation anchors at the potentially unstable John Hollis Bankhead Dam in Alabama. Working from a gallery located near the crest and extending the entire length of the dam, steel-wire anchors were placed in holes drilled through the dam and deep into the foundation. The bottom 30 ft of the anchors were grouted and allowed to set for 21 days before loading. After loading and checking, the remainder of each hole was grouted. Excellent results were obtained at a fraction of what replacement of the structure would have cost. Details of the anchors, installation, and testing are described. Anchors were also used in the right abutment and spillway piers. (USBR)
W70-05242

TARBELA--THE LARGEST DAM IN THE WORLD.

Water Resources Journal, p 13-21, June 1969. 11 p, 2 map.

Descriptors: Project benefits, Project planning, River basins, Rivers, Project purposes, Foreign projects, *Multiple-purpose projects, Outlet works, Rock fills, River basin development, *Earth dams, Hydroelectric plants, Spillways, Hydroelectric power, Hydraulic structures, Impervious blankets, *Large structures, Reservoirs, Irrigation water.
Identifiers: *Tarbela Dam (Pakistan), West Pakistan, Outlet tunnels, Superlative.

Need for huge quantities of irrigation water, indispensable to the economy of the country, and increasing demands for electrical power prompted the start of the Tarbela Dam project on the Indus River in West Pakistan. The project consists of the main dam, a reservoir blanket, 2 auxiliary dams, service and auxiliary spillways, 4 tunnels, and a powerhouse. The dams will be of earth and rockfill construction. The main dam will be 9000 ft long at the crest, 485 ft high, and will have a volume of about 139 million cu yd. The reservoir blanket and auxiliary dams will each have volumes of about 20 million cu yd. Total fill required is estimated at 185 million cu yd, making Tarbela the largest dam in the world. The spillways are conventional overflow crests controlled by sixteen 50- by 58-ft radial gates. The 4 tunnels will be about one-half mile long. Upstream from the service gates, the tunnels will have concrete linings and a diameter of 45 ft. Downstream, the tunnels will be steel lined and 3 will be 43.5 ft and one 36 ft in diameter. Ultimately, the power installation will consist of twelve 175-mw generating units. Circumstances leading to the need for the project, project benefits, reservoir silting problems, and problems of land acquisition and population resettlement are discussed. (USBR)
W70-05244

DESIGNING TO SUIT THE SOUTHERN NEVADA ENVIRONMENT,
Bureau of Reclamation, Denver, Colo.
Robert R. Rising, and Gayle A. Erickson.
Prepr 997, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct 1969. 36 p, 11 fig.

Descriptors: *Environment, Design, Nevada, Recreation facilities, Rock mechanics, *Pumping plants, *Environmental engineering, Rock bolts, Road design, Water treatment, Architecture, Pumping, Precast concrete, Tunnel design, Blasts, Structural design, Creativity, *Aesthetics, Landscaping.
Identifiers: Lake Mead, Piercing (Lakes), Raise boring, Presplitting, Blasting.

The Bureau of Reclamation has developed designs for the Southern Nevada Water Project that will protect the environment. This project is located in an area with recreational and scenic values attracting many visitors. A major problem was designing the plant to pump water from Lake Mead for project use. The designs involved rock mechanics, rock excavation for underground construction, piercing the lake at a point 100 ft below the surface, raise boring, and precast and prestressed concrete structural elements. Grouted rock bolts were used to mobilize the inherent rock strength, preventing future rockfalls. The controlling architectural concept was that the structures would blend with the natural setting. Concealment and camouflage were avoided. (USBR)
W70-05253

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05298

FOUNDATIONS AND SUBSURFACE STRUCTURES IN SNOW,
Army Terrestrial Sciences Center, Hanover, N.H.
Malcolm Mellor.
Available from the Clearinghouse as AD-699 336, $3 in paper copy, 65 cents in microfiche. Cold Regions Science and Engineering Monograph III-A2c, October 1969. 63 p, 57 fig, 31 ref. DA Project 1 T062112A130.

Descriptors: *Snow, Construction, *Foundations, Design, Loads (Forces), Underground structures, Stress, Deformation, Strain, Creep, Elasticity, Ice, Pressure, Steel, Beams (Structural), Antarctic, Foundation investigations, Cold weather construction, Excavation, Mechanical properties.
Identifiers: Supports, Atmospheric temperature.

Various types of foundations suitable for use in very deep snow are described, and design principles are given. Dependence of settlement rate on heaving pressure, size and shape of foundation, snow temperature, and snow density is treated analytically, and field data from test procedures for foundation design are outlined. In treating the design of tunnels, shafts and subsurface structures in very deep snow, the distributions of stress, strain and displacement in polar ice sheets are first obtained analytically. Observed patterns of deformation are given for a variety of excavations and deformable structures, and methods of analysis are put forward. The loading of restraining structures is discussed, and finally some notes on the monitoring and maintenance of subsurface structures are given.
W70-05302

ESTABLISHMENT OF STATE, COUNTY, AND CITY BRIDGE COMMISSIONS.
For primary bibliographic entry see Field 06E.
W70-05357

8B. Hydraulics

METHODS FOR SOLVING THE BOUNDARY LAYER EQUATIONS FOR MOVING CONTINUOUS FLAT SURFACES WITH SUCTION AND INJECTION,
Kansas State Univ., Manhattan.
V. G. Fox, L. E. Erickson, and L. T. Fan.
AIChE Journal, Vol. 14, No. 5, p. 726-736, 1968. 13 ref., 9 fig.

Descriptors: *Heat transfer, *Boundary processes, *Boundary layers, Air-water interfaces, Convection, Evaporation, Energy transfer, Turbulent boundary layers, Reynolds number, Momentum transfer, Mathematical studies, Velocity, Temperature.
Identifiers: *Laminar boundary layers.

Several new and modified methods for solving differential equations describing the laminar boundary layer behavior on a moving continuous flat sheet with suction and injection are presented. Results are obtained for a wide range of the injection parameter, f (0), at Prandtl and Schmidt numbers of 1, 10, and 100. Those methods which permit hand calculation of the properties of interest are compared using the numerical solutions of the boundary layer differential equations as the exact solutions. The new integral method of Hanson and Richardson, which gives results for the momentum thickness that deviate less than 2.2% from the exact values is recommended for predicting values of the momentum boundary layer parameters. The Von-Karman-Pohlhausen method, which was modified to account for suction and injection is most generally valid. This method gives acceptable values of the transfer coefficients for heat, mass, and momentum transfer for most of the values considered. (Novotny-Vanderbilt)
W70-05044

MASS TRANSFER THROUGH HORIZONTAL LIQUID FILMS IN WAVY MOTION,
California Univ., Berkeley.
S. L. Goren, and R. V. S. Mani.
AIChE Journal, Vol. 14, No. 1, January 1968, p. 57-61, 6 fig., 10 ref.

Descriptors: *Mass transfer, Boundary processes, Diffusion, Heat transfer, Waves, Vibrations, Turbulence, Mixing, Reaeration, Films, Dissolved oxygen, Air-water interfaces.
Identifiers: Wave action.

The effect of standing waves of controlled amplitude and frequency on the steady state rate of mass transfer through thin horizontal liquid layers is studied experimentally. The variables studied are the film thickness, the amplitude and frequency of the waves, and the spacing between the probes generating the waves. A bulk motion of complicated pattern known as drift is caused by the finite amplitude of the waves. The rate of mass transfer in the absence of imposed vibration is two to three times greater than that expected by molecular diffusion alone. Vibration increases the rate up to an order of magnitude or more, depending on the hydrodynamic conditions. The data at low frequencies are correlated by an expression of the form (i- (i sub o))/ (i sub diff) = KA (f to the 3/4th) (h to the 1/2) (L to the -1/2). (Novotny-Vanderbilt)
W70-05045

DENSITY INDUCED RETURN CURRENTS IN OUTLET CHANNELS,
Technische Hogeschool, Delft (Netherlands). Dept. of Civil Engineering.
B. P. Rigter.
Journal of the Hydraulics Division, ASCE, Vol 96, No HY2, Proc. Paper 7086, p 529-546, February, 1970. 16 fig, 3 tab, 6 ref.

Descriptors: *Channel improvement, *Density currents, *Flow, *Hydraulics, *Return flow, Estuaries, Hydraulic models, Salinity, Water quality.

When a channel discharges freshwater into a basin filled with salt water an arrested salt water wedge will be developed. A return current of salt water develops from the basin to the mixing region. The theory of two-layer flows is applied to determine the maximum return current. When the equation defining the backwater curve of a homogeneous flow with zero bottom slope is integrated, it becomes a function of a1a2, thickness of layers 1,2, respectively; a, total depth, q, thickness of layer at any point, and (x1 - x2) the horizontal distance between two points. There are two possible shapes of the back water depending upon the sign of the numerator of the function within integral sign. When slopes become important, theory does not hold because of curved streamline. Non-dimensional graphs are given and measurements in nature and model show good agreement. It is concluded that return current is highly sensitive to the length-to-depth ratio and to the internal Froude number, (Fo), of the discharged water, and thus to the cross-sectional area. This theory can be applied where a sill separates two basins with water of different densities. Other technical applications are, when an outlet channel is to be designed for outlet sluices, the flow pattern resulting from the density differences can be computed approximately. When an outlet channel is to be designed for cooling-water outlets, so that the water released into the basin has as low temperature as possible, the channel should be so designed that the internal Froude number will be low. Air currents can be used in river mouths as pneumatic barriers to prevent salt water intrusion. (Upadhyaya-Vanderbilt)
W70-05046

GRAPHICAL SOLUTION OF HYDRAULIC JUMP,
Utah State Univ., Logan. Dept. of Civil Engineering.
Roland W. Jeppson.

ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7014, p 103-108, January 1970. 6 p, 2 fig, append.

Descriptors: *Hydraulic jump, *Open channel flow, Froude number, Roughness (Hydraulic), Surges, Water levels, Standing waves.
Identifiers: Nomographs.

Nomograms are developed to give complete graphical solutions to the implicit hydraulic jump equation for flow in trapezoidal and triangular channels as well as the explicit equation for an hydraulic jump in a rectangular channel. The nomograms were constructed by combining alignment charts which solve the linearized components of the equation to graphical plots containing a graphical representation of the nonlinear components of the equation. (Knapp-USGS)
W70-05060

LIMIT SLOPE IN UNIFORM FLOW COMPUTATIONS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
Nagar S. Lakshmana Rao, and Kalambar Sridharan.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7011, p 95-102, January 1970. 8 p, 3 fig, 1 ref, append.

Descriptors: *Uniform flow, *Slopes, *Open channel flow, Froude number, Channel morphology, Discharge (Water), Water levels, Roughness (Hydraulic), Mathematical studies.
Identifiers: Limiting slopes (Uniform flow).

A method to prepare design charts for uniform flow in open channels is presented by introducing the concept of limit slope which is the smallest critical slope for a given channel shape and roughness. Equations are obtained for limit slope in rectangular, parabolic, and circular channels. The condition for limit slope in trapezoidal channels is given and it is shown that no limit slope exists for Z more than 0.5. The design chart correlating the Froude number, discharge, depth of flow and bed slope is presented for rectangular, parabolic, and trapezoidal channels. It is shown that for a given bed slope, width and roughness, the maximum Froude number in rectangular channels always occurs at a depth equal to 1/6 the width and a simple expression is given for its value. (Knapp-USGS)
W70-05061

NUMERICAL METHOD OF COMPUTING FLOW PROFILES,
Indiana Dept. of Natural Resources, Indianapolis. Surface Water Section.
Ramanand Prasad.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY 1, Paper 7005, p 75-86, January 1970. 12 p, 4 fig, 1 tab, 7 ref, 3 append.

Descriptors: *Computer programs, *Flow profiles, *Gradually varied flow, Hydraulics, Backwater, Streamflow, Open channel flow, Digital computers, Water levels.
Identifiers: Flow profile computation.

A simple rapidly converging iterative method of computing gradually varied steady flow profiles in open channels of any shape, prismatic or nonprismatic, is presented. The method is also applicable to spatially varied steady flow. It is not necessary to determine the shape of the expected profile or the type of flow in advance to proceed with the solution. Computations can proceed either upstream or downstream, regardless of the type of flow, once the channel, discharge, and the initial depth of flow are specified. The procedure for hand computation is illustrated by an example and a Fortran program is given. (Knapp-USGS)
W70-05062

NUMERICAL SOLUTION OF SAINT-VENANT EQUATIONS,
California Univ., Davis. Dept. of Water Science and Engineering.
Theodor Strelkoff.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, no HY1, Paper 7043, p 223-252, January 1970. 30 p, 5 fig, 30 ref, append.

Descriptors: *Gradually varied flow, *Open channel flow, *Equations, *Unsteady flow, *Mathematical studies, Computers, Canals, Waves (Water), Hydraulics, Mathematical models.
Identifiers: Saint-Venant equations.

The general, one-dimensional Saint-Venant equations are presented for a rigid open channel of arbitrary form, not necessarily prismatic, containing a flow that may be spatially varied. The theoretical basis for the method of characteristics is reviewed and used to show that in the general case the speed of long-wave disturbances is given by the slope of the characteristic curves. Finite-difference schemes on a rectangular net in the x - t plane and based on the characteristic forms of the Saint-Venant equations as well as on the direct forms are given and examined for their stability. The vov Neumann technique for stability analysis is presented in detail. Explicit numerical schemes, which are simple, but require small steps in time because of stability problems, are contrasted with implicit schemes that permit numerical solution over large time steps but require the solution of large sets of simultaneous algebraic equations at each step. The double-sweep or 'progonka' method, an exact time-and-space-saving technique for solving these (locally linearized) equations is also given in detail. (Knapp-USGS)
W70-05063

MANNING FORMULA -- A MISNOMER,
Geological Survey, Washington, D.C. Water Resources Div.
Garnett P. Williams.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY1, Paper 7036, 193-200, January 1970. 8 p, 35 ref.

Descriptors: *Mannings equation, *Reviews, *Bibliographies, Evaluation, Open channel flow, Discharge coefficients, Streamflow, Roughness (Hydraulic), Discharge (Water).

No one ever proposed the popular Manning formula in the form commonly used today. At least ten papers, beginning with that of Gauckler in 1867, offered a monomial equation for certain flow conditions. Manning's paper, 1891, was the fifth, chronologically, in this group of papers. The Frenchman Flamant is primarily responsible for first attributing the formula to Manning and for introducing the resistance coefficient n. H. T. Bovey is known to have been, in 1901, the first to write the equation in the form used today for English units. The expression 'Manning's n' first crept into the literature in 1916 and represented a rather ironic development, as Manning had clearly rejected the use of the coefficient n. (Knapp-USGS)
W70-05064

COMPUTATIONAL PROCEDURES FOR FLOW RESISTANCE LAWS,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 07C.
W70-05127

HOT-FILM TURBULENCE MEASUREMENTS IN WATER FLOW,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 07B.
W70-05128

INTEGRATING-FLOAT MEASUREMENTS IN TURBULENT FLOWS,
Missouri Univ., Columbia. Dept. of Civil Engineering, and Public Health Service, Columbia, Mo.
For primary bibliographic entry see Field 07B.
W70-05140

CHANNEL SLOPE EFFECT ON PEAK DISCHARGE OF NATURAL STREAMS,
Washington Suburban Sanitary Commission, Hyattsville, Md., and Greenhorne and O'Mara, Inc., Riverdale, Md.
For primary bibliographic entry see Field 02E.
W70-05141

CHARACTERISTICS OF SELF-AERATED FLOWS,
Indian Inst. of Science, Bangalore. Dept. of Civil and Hydraulic Engineering.
Nagar S. Rao Lakshmana, Kyatasandra Seetharamiah, and Thimmaiah Gangadharaiah.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7055, p 331-355, February 1970. 25 p, 11 fig, 3 tab, 16 ref, append.

Descriptors: *Open channel flow, *Air entrainment, *Aeration, Turbulent flow, Mixing, Model studies, Hydraulic models, Air, Dispersion, Eddies, Vortices.
Identifiers: Self-aerated flows.

Characteristics of self-aerated flows in open channels are studied by dividing the flow into two zones: (1) wall turbulent zone; and (2) free turbulent zone. Theoretical equations developed for air concentration and velocity in the free turbulent zone, starting from the basic equations of motion and continuity are checked with experiments conducted in a tilting flume and the agreement between them is shown to be good. The terms air-water density and air-water velocity are defined and equations are presented correlating them with air concentration. In accordance with the new delfinitions, Halbronn's method of measuring air-water velocity is modified and used in the investigations. An empirical relationship between bulkage depth and mean air concentration is presented. (Knapp-USGS)
W70-05143

RIPPLE CONCENTRATION AND FRICTION FACTOR,
South Dakota State Univ., Brookings. Dept. of Civil Engineering.
Fred F. M. Chang.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY2, Paper 7067, p 417-430, February 1970. 14 p, 8 fig, 1 tab, 22 ref, append.

Descriptors: *Open channel flow, *Alluvial channels, *Ripple marks, *Sand waves, *Roughness (Hydraulic), Flow resistance, Hydraulics, Fluid friction, Bed load, Turbulent flow, Turbulence.
Identifiers: Ripple concentration.

Flow over ripples in alluvial channels is essentially the same as the flow over rigid roughness elements, the main difference lying only in the shapes of the ripples and roughness elements. The total friction factor is the summation of grain-roughness friction factor and form-roughness friction factor. Nikuradse's formula for grain-roughness friction factor is found to be satisfactory in determining the value of grain-roughness friction factor for the flow in alluvial channels. The form-roughness friction factor is proportional to the 'exposure parameter' and inversely proportional to mean relative height of the ripples. It is also proportional to the coefficient of expansion loss, which is found to be a function of the mean relative height of the ripples. (Knapp-USGS)
W70-05154

VERTICAL TRANSFER IN OPEN CHANNEL FLOW,
Geological Survey, Fort Collins, Colo.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.

Harvey E. Jobson, and William W. Sayre.
Journal Hydraulics Division, ASCE Proceedings, Vol 96, No HY3, Paper 7148, p 703-724, March 1970. 22 p, 15 fig, 1 tab, 16 ref, append.

Descriptors: *Open channel flow, *Dispersion, *Mixing, *Turbulent flow, *Path of pollutants, Turbulence, Sedimentation, Settling velocity, Mass transfer, Dye releases, Hydraulic models, Hydraulics, Model studies, Tracking techniques, Tagging, Roughness (Hydraulic).
Identifiers: Turbulent dispersion.

Vertical turbulent mass transfer coefficients for suspended sediment particles and dye, and fall velocities of the sediment particles were determined experimentally in a large laboratory flume. Local values of the turbulent mass transfer coefficient, and turbulent fall velocities for the sand, were determined from an integrated form of the transfer equation. The results of the experiments indicate that: (1) Magnitude and distribution of the vertical turbulent mass transfer coefficient for dye and fine sediment are close to those of the momentum transfer coefficient, which lends added support to Reynolds' analogy for the equivalence of mass and momentum transfer in turbulent shear flow; (2) in comparison with dye, the mass transfer coefficient for medium sand is somewhat less in magnitude and its distribution indicates that the transfer coefficient is larger near the bed; and (3) the fall velocity of sediment particles is larger in turbulent channel flow than in quiescent water. (Knapp-USGS)
W70-05160

MACROTURBULENT FLOW IN STEEP OPEN CHANNELS WITH HIGH NATURAL ROUGHNESS,
Fritz Hartung, and Helmut Scheuerlein.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A1, p 1-8, 1967. 8 p, 6 fig.

Descriptors: *Turbulent flow, *Open channel flow, *Model studies, *Hydraulic models, Turbulence, Roughness (Hydraulic), Roughness coefficient, Supercritical flow, Channel morphology, Mixing.
Identifiers: Macroturbulent flow.

Macroturbulent flow in open channels was studied in laboratory flumes. Macroturbulent flow is characterized by steep slope, large roughness, relatively small discharge, and forced mixing with air. By considering only the component in the main direction of flow, no agreement with well-known flow formulas could be achieved even taking into account the entrained air by working with a lower density of the air-water mixture. This discrepancy is certainly a consequence of the high-grade turbulence which is superimposed on the main flow direction. Formulas describing this type of flow were tried using 2 different analyses of the measurements. One of them leads to a simple resistance function by assuming imaginary velocities. (Knapp-USGS)
W70-05189

A STUDY OF THE ROUGHNESS OF CONCEPTUAL RIVER SYSTEMS OR WATERSHEDS,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Illinois Univ., Urbana. Dept. of Hydraulic Engineering.
T. E. Harbaugh, and Ven Te Chow.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A2, p 9-17, 1967. 9 p, 8 fig, 11 ref.

Descriptors: *Roughness (Hydraulic), *Roughness coefficient, *Mathematical models, Model studies, Equations, Overland flow, Runoff, Routing, Rainfall-runoff relationships, Raindrops.
Identifiers: *Watershed models, Watershed roughness.

The roughness of a conceptual river system or watershed is investigated by mathematical formulation and laboratory experimentation. By mathematical formulation, the watershed is considered as a quasi-linear distributed dynamic system. The hydraulic behavior of this system representation is described by a set of quasi-linear partial differential equations of continuity and momentum equations which define the spatially varied unsteady flow. The conceptual watershed is composed of the overland flow part and the main channel flow part. The equations are first applied to the overland flow phase due to input rainfall and then to the main channel flow phase using the overland flow as input. Solution of the equations is made in their finite-difference forms on digital computers. The friction slope in the energy equation is expressed by a conceptual measure of the watershed roughness. This conceptual roughness is further evaluated in a laboratory study of the watershed in various shapes and slopes and its sensitivity to depth of flow and raindrop impact on the laboratory watershed is disclosed. (Knapp-USGS)
W70-05190

UNIFORM FLOW IN IDEALIZED CHANNEL-FLOOD PLAIN GEOMETRIES,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
J. W. Delleur, G. H. Toebes, and B. C. Udeozo.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A27, p 218-225, 1967. 8 p, 2 fig, 1 tab, 5 ref. USDA Contract No 12-14-100-8895 (41).

Descriptors: *Flood routing, *Open channel flow, *Channel morphology, *Flood plains, *Hydraulic models, Model studies, Reynolds number, Hydraulic similitude, Alluvial channels, Routing.
Identifiers: Flood plain model.

The growing intensity of land and water resources utilization has renewed efforts towards systematic research in the field of fluvial hydraulics. The flow through a prismatic channel-flood plain geometry is a necessary bounding condition to the cases of river channel nonuniformity. Experiments were made using three channel geometries, each consisting of a small rectangular channel, as the main river channel, connecting to a much wider rectangular channel on top, as the flood plain. The models were made of varnished plywood. In one of the geometries, the flood plain section was lined with an expanded metal mesh to simulate the condition in natural rivers where the roughness coefficient of the flood plain is much higher than that of the main channel. For each geometry, nine flow conditions were tested. The Froude numbers varied from 0.34 to 1.38 and the slopes varied from 0.00067 to 0.00378. Detailed velocity distributions were taken from which lines of equal velocity were obtained. When the flood plain is not very wide compared to the main channels, there is a substantial interference between the two flows. On the contrary, when the flood plain is wide compared to the main channel, there is little interference between the two flows. The results of the investigation of energy losses indicate that the Darcy-Weisbach friction coefficient decreases with the Reynolds number, and increases with the hydraulic radius. (Knapp-USGS)
W70-05191

RECOGNITION OF SCOUR OF RIVER CHANNEL FOR DESIGN PURPOSES,
Corps of Engineers, Kansas City, Mo.
Gerald B. Swanson.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A15, p 115-122, 1967. 8 p, 4 plate, 1 tab.

Descriptors: *Scour, *Erosion, *Alluvial channels, Rivers, Hydraulics, Roughness (Hydraulic), Stage-discharge relations, Manning equation, Backwater, Open channel flow, Channel morphology.
Identifiers: Scour prediction.

Backwater computation to determine the design water surface for protective works is based on fixed cross sections obtained from hydrographic surveys usually taken during periods of low flow. A comprehensive study of these cross sections and ones obtained at identical locations by sonic soundings during flood show that marked changes of depth and section occur with increased stage and discharge. The main channel flow is analyzed and the effect of section change, bed material size, and other factors are assessed by using a variable roughness coefficient 'n' as it is used in the Manning equation for backwater computations. (Knapp-USGS)
W70-05199

SOME EXPERIMENTAL OBSERVATIONS ON FREE SURFACE SHEAR FLOW OVER A WAVY BOUNDARY,
Ecole Polytechnique, Montreal (Quebec); and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Luc Robillard, and John F. Kennedy.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A6, p 41-48, 1967. 8 p, 4 fig, 2 tab, 4 ref.

Descriptors: *Supercritical flow, *Open channel flow, *Waves (Water), Standing waves, Currents (Water), Velocity, Turbulence, Model studies, Hydraulic models, Laboratory tests, Roughness (Hydraulic).
Identifiers: Kinematic waves.

Laboratory experiemtns on supercritical flow over rigid beds of sinusoidal form in a rectangular cross-section channel revealed the existence of oblique, stationary surface waves, one wave emanating from each bed wave. Measurements of velocity distributions traced the origin of these waves to periodic variations in the displacement thickness of the boundary layers of the vertical walls of the test section. Predictions of the inclination of these waves from kinematical considerations are found to be in good agreement with measured values. The variations in the displacement thickness are explained in terms of induced secondary currents arising from centrifugally generated pressure distributions and convective acceleration of the retarded fluid near the flume walls. The form of the velocity profiles both outward from the lateral walls and upward from the bed was found to vary widely along a bed wave. (Knapp-USGS)
W70-05202

RESISTANCE TO FLOW IN FIXED-BED CHANNELS WITH THE INFLUENCE OF CROSS-SECTIONAL SHAPE AND FREE SURFACE,
Genoa Univ. (Italy). Inst. of Hydraulics.
Enrico Marchi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A5, p 32-40, 1967. 9 p, 7 fig, 10 ref.

Descriptors: *Open channel flow, *Closed conduit flow, Turbulent flow, Mathematical models, Roughness (Hydraulic), Turbulent boundary layers, Hydraulic models.
Identifiers: Fixed-bed channels.

The analytical transfer of the velocity and resistance laws from circular pipes to closed-conduits of general cross-sectional configuration and to open channels, meets the known difficulties which are due to the non-uniform distribution of the wall shear stress and, in the latter case, due also to the free surface influence. The study is approached by introducing a new expression of the velocity distribution along normals to the wall. This law, which contains the logarithmic one as a limit-law in the wall region, appears to be substantially justified by the experimental observations. From it, following a classic pattern, the resistance laws are deduced.

The possibility of interpreting the effect of section shape, and also the free surface influence in open channels, are shown with the introduction of only one shape coefficient, which appears as a multiplier of the hydraulic radius. Results of tests on channels with homogeneous and nonhomogeneous roughness, conducted in 1957-1960 gave some values of the shape coefficient. (Knapp-USGS)
W70-05203

HYDRAULIC RESISTANCE OF A MOVABLE CHANNEL BED AND SEDIMENT GRADING INFLUENCE,
Akademiya Nauk Armyanskoi SSR, Erevan.
For primary bibliographic entry see Field 02J.
W70-05206

WATER HAMMAR ANALYSIS,
Michigan Univ., Ann Arbor.
Victor L. Streeter.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY6, p 1959-1972, Nov 1969. 14 p, 12 fig, 3 ref, 2 append.

Descriptors: *Water hammer, Computers, Flow control, Fluid flow, Fluid friction, Hydraulics, Pipe flow, Transients, *Digital computers, Failure (Mechanics), Computer programming, Pipelines, Friction, *Analysis, Vapor pressure, Velocity, Discharge (Water), Pumps, Hydrodynamics, Equations.
Identifiers: Boundary conditions, Method of characteristics, Transient flow.

Digital computer methods have been replacing graphical methods of water hammer analysis. Simplified methods of calculating hydraulic transients are given with techniques for increasing the computing time interval over that permitted by the characteristic method. Lumping and interpolation methods are compared with mixed implicit and characteristic methods. Complex boundary conditions are examined, including a springmass system with coulomb friction, an accumulator with inertia and fluid friction, pump failures, and column separation. (USBR)
W70-05233

A UNIFORM FLOW FORMULA FOR FLUMES AND CANALS,
Mississippi State Univ., State College.
Brahm P. Verma, and John C. McWhorter.
Pap 69-746, Amer Soc Agr Eng 1969 Winter Meet, Chicago, Ill, Dec 1969. 19 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Uniform flow, *Equations, *Flumes, *Canals, *Irrigation canals, Chezy equation, Turbulent flow, Laboratory tests, Concrete-lined canals, Hydraulics, Hydraulic models, Fluid flow, Fluid mechanics.
Identifiers: *Formulas, Concrete linings.

A dimensional analysis was made for the common case of uniform, turbulent flow. An experiment in a laboratory flume and the analysis of data obtained established a uniform flow formula applicable to data obtained from literature on uniform flow in flumes and large, concrete-lined irrigation canals. The study was conducted in 4 steps: (1) analyzing the problem dimensionally, (2) conducting a flume test for appropriate data collection, (3) analyzing data to establish a prediction equation that described uniform flow, and (4) comparing the prediction equation with data obtained from literature on uniform flow in flumes and fixed canals. (USBR)
W70-05234

BOUNDARY CONDITIONS FOR AIR CHAMBERS AND SURGE TANKS,
British Columbia Univ., Vancouver.
Eugene Ruus, and M. Hanif Chaudhry.
Trans Eng Inst Can, Vol 52, No 11, p 45-50, Nov 1969. 6 p, 10 fig, 6 ref, append.

Descriptors: *Water hammer, Fluid mechanics, *Surge tanks, Digital computers, *Air chambers, Pressure head, Flow control, Fluid friction, Fluid flow, Hydraulics, Transients, Analysis, Vapor pressure, Foreign research, Velocity, Discharge (Water), Differential equations, Unsteady flow, Pumps, Wave velocity, Pipelines.
Identifiers: *Boundary conditions, Canada, Analytical method, Method of characteristics, Accuracy.

Air chambers or surge tanks are often provided on discharge lines to reduce water hammer caused by failure of a pump or by rapid closing or opening of a flow-regulating device. For long discharge lines having large head losses, air chambers are economical; surge tanks are preferred for short pipelines carrying large discharges. Either device should be connected to the pipeline as close to the source of disturbance as practicable. Equations of momentum and continuity of unsteady flow through closed conduits because of their nature have no possible solution. Graphical methods evolved are approximate and cannot be used for large, complicated systems. The method of characteristics for solving the continuity and momentum equations by a digital computer is more accurate and can be used for complicated pipe systems. Equations representing the boundary conditions for air chambers and surge tanks are given. (USBR)
W70-05239

EROSION AT THE BASE OF FLIP BUCKETS,
Winsor Univ. (Ontario).
For primary bibliographic entry see Field 02J.
W70-05245

HYDRAULIC PROPERTIES OF STREETS.
Los Angeles Dept. of Public Works, Calif.

Office Standard, No. 94, April 11, 1949 (Revised Oct. 5, 1950). 16 p, 17 fig, 1 tab.

Descriptors: *Hydraulic properties, *Hydraulic design, *Hydraulics, *Flow characteristics, *Hydraulic engineering, *Drainage engineering, *Surface drainage, *Paving, *Drainage practices, *Road design, Surface runoff.
Identifiers: *Street design, *Gutter design, *Hydraulic properties of streets, *Los Angeles, Municipal engineering.

The publication comprises a set of 10 charts which can be used to simplify the otherwise complicated mathematics involved in making computations of stormwater drainage flows and hydraulic properties of street and gutter sections. The charts were developed and published for use in the City Engineer's Office of Los Angeles. Collectively, the charts are designated as Office Standard No. 94 of the Storm Drain Division. Given the gutter slope, rate of stormwater flow (cfs), and the cross-fall of the street section, values of gutter flow-depth, width of gutter flow and flow velocity can be obtained from a single chart representative of the appropriate street and pavement widths. Alternatively, given the gutter flow-width, gutter slope, and cross-fall, values of gutter flow-depth and futter flow capacity (cfs) can be obtained from the same chart. Each chart is designed for a specific pavement width and street width, varying from 40 ft. to 100 ft. street widths. All charts are based on 8 inch curb heights. A chart for converting other heights is given. (Poertner-Chicago)
W70-05257

HYDRAULIC ANALYSIS OF JUNCTIONS,
Los Angeles Dept. of Public Works, Calif.
Donald Thompson, Irving R. Cole, and Floyd J. Doran.
Office Standard, No. 115, 1968. 37 p, 38 fig.

Descriptors: *Hydraulic design, *Hydraulics, *Flow characteristics, *Sewers, *Hydraulic engineering, *Hydraulic properties, *Head loss, *Junctions, Hydraulic gradient, Energy losses, Pipe, Open channels.
Identifiers: *Junction losses, *Hydraulic analysis of junctions, Los Angeles, Municipal engineering.

This monograph discusses the development and practical applications of a newly developed mathematical formula for use by engineers in computing energy and pressure losses at junctions of sewer pipes and open channels. The formula is based on the 'pressure plus momentum' theory which equates the summation of all pressures acting at a junction with the summation of the momentums. The use of the formula affords a rational method of analyzing hydraulic losses when designing either sanitary, storm, or combined sewer systems. The 'pressures' which must be evaluated are those at (1) upstream end of junction, (2) downstream end, (3) conduit wall, (4) invert, and (5) soffit. The general formula presented in this monograph simplifies calculations by making unnecessary the evaluation of these individual pressures. It is shown that, regardless of conduit shape, the summation of all pressures acting at the junction, ignoring friction, equals the average cross-sectional area through the junction multiplied by the change in the hydraulic gradient. The derivation of the formula is presented together with sample problems and solutions illustrating computations of hydraulic changes at junctions, for both subcritical and supercritical flows. (Poertner-Chicago)
W70-05258

HYDRAULIC PROPERTIES OF PIPE, BOXES, AND RECTANGULAR CHANNELS,
Los Angeles Dept. of Public Works, Calif.
Lyall A. Pardee.
Office Standard No. 116, 1966. 65 p.

Descriptors: *Hydraulic design, *Hydraulics, *Flow characteristics, *Hydraulic engineering, *Hydraulic properties, *Pipes, *Open channels, Energy gradient, Hydraulic gradient.
Identifiers: *Los Angeles, *Municipal engineering.

The monograph presents design formulas and tables for use by engineers engaged in designing and analyzing the flow of liquids through pipes. The publication is primarily intended for use in designing water conveyance conduits in sewer systems, water supply systems and irrigation systems. Various cross-sections of conduits are considered including circular pipe, box sections, and rectangular channels. The individual tables simplify flow computations that are based upon conventional, but complicated, formulae. All possible flow depths are included in the tables, in increments of 2, 3, or 6 inches, depending upon the size of conduit. The tables are based upon the assumption that 'uniform' flow conditions prevail. (Poertner-Chicago)
W70-05259

HYDRAULIC AND MIXING CHARACTERISTICS OF SUCTION MANIFOLDS,
Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
For primary bibliographic entry see Field 05G.
W70-05468

RESISTANCE TO FLOW OVER TWO-DIMENSIONAL STRIP ROUGHNESS,
Roorkee Univ. (India). Dept. of Civil Engineering.
K. G. Ranga Raju, and Ramachandra J. Garde.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7181, p 815-834, March 1970. 20 p, 10 fig, 1 tab, 17 ref, append.

Descriptors: *Roughness (Hydraulic), *Open channel flow, *Flow resistance, Model studies, Hydraulic models, Turbulent flow, Turbulence.
Identifiers: Wind tunnel studies.

Wind tunnel and open channel experimental data on the resistance of two-dimensional strip roughnesses kept on a plane boundary were analyzed. At low Froude number, in the range of

relative spacing from 2.5 to 40.0, the total (effective) resistance of the plane boundary can be taken as equal to the form resistance of the roughness elements. The resistance relation was put in the form of an empirical equation. Comparison of this equation with the conventional resistance equations for artificial roughness shows that the datum may be located at the level of the plane boundary for relative spacing less than 5.0 and should be located higher at smaller spacings, if the conventional equation is to be used. Large errors can result if the method proposed by Morris is used to predict the resistance in case of flow over strip roughnesses. (Knapp-USGS)
W70-05483

DYNAMIC EQUATIONS FOR STEADY SPATIALLY VARIED FLOW,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, and Harry G. Wenzel, Jr.
ASCE Proceedings, Journal Hydraulics Division, Vol 96, No HY3, Paper 7179, p 801-814, March 1970. 14 p, 1 fig, 14 ref, 3 append.

Descriptors: *Open channel flow, *Unsteady flow, *Non-uniform flow, *Equations, Mathematical studies, Chezy equation, Darcy-Weisbach equation, Slopes, Mannings equation.
Identifiers: Spatially varied flow.

Dynamic equations for steady spatially varied flow in uniform channels are derived separately based on momentum and energy principles. It is shown that the momentum equation is inherently different from the energy equation. In general, six different gradients are involved in steady spatially varied flow: the friction slope in the momentum equation, the dissipated energy gradient in the energy equation, the total head gradient, the gradient of the piezometric head, the free surface slope, and the channel slope. Conventional practice of using the Manning, Chezy, or Weisbach formulas to evaluate the friction slope or the dissipated energy gradient is only an approximation. (Knapp-USGS)
W70-05484

DIFFUSION BELOW SUBMERGED RECTANGULAR OUTLETS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and D. Muralidhar.
Supported by the National Research Council of Canada. Journal of Hydraulic Research, Vol 7, No 2, p 251-274, 1969. 24 p, 14 fig, 2 tab, 12 ref.

Descriptors: *Open channel flow, *Jets, Hydraulics, *Outlets, Open channel flow, Turbulent flow, Hydraulic structures, Canals, Rivers, Channel morphology, Model studies, Hydraulic models.
Identifiers: Submerged outlets.

A number of hydraulic structures like river and canal outlets sometimes discharge under submerged conditions. For developing safe but economical designs for the energy dissipators for these outlet works, a good knowledge of at least the mean diffusion characteristics of the flow is necessary. An experimental study was made of part-width rectangular wall jets with an abrupt drop and part-width rectangular wall jets located with an eccentricity with respect to the center line of the downstream channel. (Knapp-USGS)
W70-05512

FLOW PHENOMENA NEAR ROUGH BOUNDARIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Emmett M. O'Loughlin, and V. S. Shastri Annambhotla.
Journal of Hydraulic Research, Vol 7, No 2, p 231-250, 1969. 20 p, 3 fig, 7 ref. ONR Contract Nonr-1509 (03).

Descriptors: *Turbulent flow, *Boundary processes, Roughness (Hydraulic), Hydraulics, Interfaces, Turbulence, Open channel flow, Closed conduit flow, Steady flow, Reynolds number, Laminar flow, Boundary layers, Model studies, Hydraulic models.
Identifiers: Eddy diffusion.

Velocity profiles of flows over boundaries covered with spaced roughness elements exhibit systematic departures from the logarithmic profile, departures which affect predictions of resistance and transfer processes occurring at a rough boundary. A model, based upon the apparent nature of the eddy diffusion coefficient, is used to develop an expression for velocity profiles close to rough boundaries. Observations in an air conduit and an open channel support the concept, suggested by dimensional reasoning, that the velocity distribution should be determined by a modified 'inner' law. The stability criterion of the viscous sublayer on the smooth boundary between roughness elements is evaluated. It is shown that the limiting sublayer Reynolds number is comparable to that obtained in smooth-pipe experiments. (Knapp-USGS)
W70-05517

FLOOD CONTROL CHANNEL HYDRAULICS,
Corps of Engineers, Los Angeles, Calif. Hydraulics Section.
Albert P. Gildea, and Ralph F. Wong.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A41, p 330-337, 1967. 8 p, 12 fig, 1 tab.

Descriptors: *Open channel flow, *Hydraulic design, *Flood control, Channel improvement, Floodways, Flumes, Turbulent flow, Flow resistance, Model studies, Hydraulic models.
Identifiers: High velocity open channel flow.

Concrete-lined open channels having a rectangular or trapezoidal cross section have become increasingly necessary and well justified to control floods for the protection of highly developed industrial and urban areas located on steep-gradient streams in the United States. Methods are described for resolving some of the problems encountered when high velocity flow traverses short radius curves in both rectangular and trapezoidal channels and when two high velocity tributary flows join at a confluence. Illustrations of prototype and model installations are given for designs used in the construction of flood control channels by the Corps of Engineers in Southern California. (Knapp-USGS)
W70-05523

A THEORY OF STABILITY OF STREAMS,
Nagoya Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-05524

ON A SOLUTION OF BED FLUCTUATION IN OPEN CHANNEL WITH MOVABLE BED OF STEEP SLOPE,
Kobe Univ. (Japan). Dept. of Civil Engineering.
Junzaburo Matsunashi.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A44, p 354-361, 1967. 8 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Channel morphology, *Alluvial channels, Sediment transport, Regime, Mathematical studies, Model studies, Bed load, Dunes, Ripple marks, Roughness (Hydraulic).
Identifiers: Streambed form.

In open channel flow with steep movable bed, undulations such as anti-dunes, the wavy profiles of which propagate generally in the direction of upstream, are formed on the bed surface. The propagating velocity is very slow in general and the profiles are regular. The free surface of fluid moving throughout over the bed surface fluctuates according to the bed undulations, so that wavy profiles of the free surface propagate very slowly in the same direction as the profiles of the bed surface, and often the amplitudes increase together in size with distance in the direction of flow. With a critical wave size the wavy profiles of the bed surface may be flushed out by hydraulic jump. (Knapp-USGS)
W70-05526

ON THE VELOCITY COEFFICIENT AND HYDRAULIC ROUGHNESS IN MEANDERING WATERCOURSES,
Research Inst. for Water Resources Development, Budapest (Hungary). Dept. for Hydromechanics.
For primary bibliographic entry see Field 02E.
W70-05527

THE KINETIC ENERGY CORRECTION FACTOR AND THE MOMENTUM CORRECTION FACTOR IN OPEN CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
V. Strauss.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A39, p 314-323, 1967. 10 p, 4 fig, 4 ref.

Descriptors: *Open channel flow, *Kinetics, Momentum transfer, Turbulent flow, Channel morphology, Mathematical studies, Streamflow.
Identifiers: Kinetic energy correction factor.

The effect of the velocity distribution and section shape of open channels on the value of the kinetic energy correction factor and of the momentum correction factor is discussed. By introduction of dimensionless shape parameters of the channel and under the general assumption that the velocity distribution is vertical the equations for correction factors are derived. These are valid for the usual simple and combined channel sections. On the basis of the theoretical analysis of these equations the effect of the channel shape and velocity distribution are determined. The theoretical results and direct measurements in open flows confirm that the values of the correction factor are often much higher than the generally used values in the range 1.0 - 1.1. (Knapp-USGS)
W70-05528

CALCULATION PROCESS OF POLYGONAL CROSS-SECTION CANALS (FRENCH),
Toulouse Univ. (France). Institut de Mecanique des Fluides.
Yves Labye, and J. Nougaro.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A37, p 297-306, 1967. 10 p, 5 fig.

Descriptors: *Open channel flow, *Hydraulics, *Channel morphology, Mathematical studies, Mathematical models, Steady flow, Mannings equation.
Identifiers: Open channel hydraulics.

Calculation of steady flow in cylindrical canals, the cross section of which may be given by any polynomial, may be done by use of formulas identical to those used for trapezoidal canals. Very simple programs are proposed to be solved even by micro-computers, or by the use of very small tables, or abacus when circumstances prevent recourse to large computers. (Knapp-USGS)
W70-05529

A RECONSIDERATION OF THE HYDRAULIC RADIUS AS A GEOMETRIC QUANTITY IN OPEN CHANNEL HYDRAULICS,
Alabama Univ., Huntsville. Dept. of Fluid Mechanics; and Colorado State Univ., Fort Collins.
Cornelius C. Shih, and Neil S. Grigg.

Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A36, p 288-296, 1967. 9 p, 7 fig, 12 ref.

Descriptors: *Open channel flow, *Hydraulics, *Hydraulic radius, Turbulent flow, Steady flow, Model studies, Hydraulic models, Channel morphology.
Identifiers: Open channel hydraulics.

The validity of applying the hydraulic radius as a ole geometric quantity for various channel shapes in the computation of turbulent uniform flow is discussed. The flows in smooth rectangular channels of 0.24 ft. and 0.75 ft. in width were analyzed for aspect ratios ranging from about 0.5 to 10. The data collected from the two channels on mild and steep slopes are presented in graphical form and mostly through dimensionless parameters. The dimensionless parameters plotted are the friction factor, the Reynolds number, the modified Reynolds number and the aspect ratio of rectangular channels. For a given hydraulic radius, channel slope, and roughness, the increase in mean velocity of turbulent uniform flow or the decrease in flow resistance is attributed to the lowering aspect ratio. This trend toward less flow resistance appears to be more evident for the mild slope than the steep. The application of the hydraulic radius in the uniform flow analysis is valid within the limit of engineering accuracy if the aspect ratio is high (greater than about 2); the use of the hydraulic radius should be coupled with the consideration of the effect of channel shape if the aspect ratio is less than about a 2; the explicit knowledge of the effect of channel shape on the flow resistance needs to be further advanced so that a better uniform-flow formula may be made available; the relationship between the friction factor and the modified Reynolds number, is more convenient and recommendable for efficient use with the Darcy-Weisbach's uniform flow formula. (Knapp-USGS)
W70-05530

THE GRADUALLY VARIED FLOW IN NONPRISMATIC CHANNELS,
Czechoslovak Academy of Sciences, Bratislava (Czechoslovakia). Inst. of Hydrology and Hydraulics.
T. Horsky.
Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 1 (River hydraulics), Paper A34, p 272-279, 1967. 8 p, 6 fig, 6 ref.

Descriptors: *Open channel flow, *Unsteady flow, *Equations, *Discharge (Water), Streamflow, Mathematical models, Stage-discharge relations.
Identifiers: Nonprismatic open channels.

The modification and integration of the differential equation for a gradually varied flow in nonprismatic channels are described. For solution an arbitrary formula of velocity can be used. (Knapp-USGS)
W70-05531

8C. Hydraulic Machinery

DYNAMIC RESPONSE OF GUYED TOWERS TO WIND LOADING,
Bell Telephone Labs., Inc., Whippany, N.J.
K. I. Beitin.
Prepr 1032, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 30 p, 5 fig, 3 tab, 13 ref, append.

Descriptors: *Guyed towers, Gusts, *Wind pressure, Towers, *Structural behavior, Structural design, Structural models, Vibrations, Transmission towers, *Statistical methods, Natural frequency, Resonance, Flexibility, Damping, Deflection, Energy absorption, Bending, Cables.
Identifiers: Dynamic loads, *Dynamic response, Flexible structures, Vibration control, Matrix methods (Structural), Aeolian vibration.

Because of the random nature of wind action, the dynamic response of structures can be treated better statistically. A method based on the statistical theory of stationary random processes was developed to determine the dynamic response of guyed towers to gusty winds. The response of the multi-degree-of-freedom system for a given windstorm is dependent on the magnitude of resonant frequencies of vibration of the structure; the lower the frequencies the more effective is the coupling between oscillation and wind agitation. The method was applied to a 300-ft guyed tower. For this structure, the 3 sigma dynamic deflection (sigma being the standard deviation) may be as much as 1.9 times the mean deflection. This greater than expected response is attributed to the low frequencies of vibration of the guy cables and underscores the important role of cable vibration on tower motion. Improperly designed cables may produce low frequency oscillations that extract more energy from wind turbulence. The design techniques are conservative and should be used in place of the seemingly unreliable quasi-static methods. (USBR)
W70-05212

CAVITATION CHARACTERISTICS OF BALL AND BUTTERFLY VALVES,
Colorado State Univ., Fort Collins.
Raymond A. Hogan, and J. Paul Tullis.
Preprint 1056, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 39 p, 14 fig, 1 tab, 16 ref, append.

Descriptors: *Cavitation, *Butterfly valves, Hydraulic valves, Models, Prototypes, Experimental data, Instrumentation, Orifices, Performance, Discharge coefficients, Velocity, Laboratory tests, Reynolds number, Geometry, Hydraulics, Scale, Test procedures, Model tests, Hydraulic gates and valves, Bibliographies.
Identifiers: *Cavitation parameters, *Cavitation index, Test results, Cavitation noise, *Ball valves.

Application of valve cavitation data obtained experimentally is complicated by the existence of so-called scale effects. Designers are unable to apply cavitation data obtained from model tests to a prototype with confidence that the prototype will operate at or below the expected degree of cavitation. Scale effects are caused by the lack of a suitable cavitation parameter, accounting for all major factors influencing the cavitation process. Because of the unusually large number of major factors influencing cavitation and the necessity for reducing the number of variables to a tolerable level for analysis, scale effects exist. Size and pressure level scale effects related to cavitation in valves and to the application of generalized valve information are reviewed. The more popular cavitation parameters are discussed, and an attempt is made to find a more suitable cavitation parameter that would make these scale effects predictable. Information obtained from testing 3 sizes of geometrically similar, circular, concentric orifices, and results of several other investigations are included for comparison and evaluation of the proposed new cavitation parameter. (USBR)
W70-05213

SELECTION OF OUTLET WORKS GATES AND VALVES,
Warren H. Kohler.
Preprint 1057, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 30 p, 3 fig, 3 ref, append.

Descriptors: *Hydraulic gates and valves, Hydraulic gates, Hollow jet valves, Hydraulic valves, Safety, Reliability, Maintenance, Plug valves, Costs, Hydraulic design, Slide gates, *Outlet works, Sprays, Discharge (Water), Radial gates, Butterfly valves, Roller gates, Needle valves.
Identifiers: Selection, Jet-flow gates, Spherical valves.

Data and discussion outline factors involved in selecting gates or valves for outlet works. Complexity of the numerous types of gates and valves precludes detailed descriptions of the special features of each type. Only basic individual characteristics important from an overall selection standpoint are described. In selecting suitable outlet works gates or valves, the essential requirement is that all hydraulic needs are met. Usually more than one arrangement of gates or valves will meet basic hydraulic requirements. Other factors should be considered in the arrangement and selection of equipment for outlet works, including safety, reliability, general arrangement, operation conditions, maintenance, and costs. Selection always involves some compromises in providing an optimum solution, but safety, reliability, and sound hydraulics are not subject to compromise. (USBR)
W70-05214

SUB-SPAN GALLOPING EASED ON EHV LINE.

Elec World, Vol 172, No 24, p 34-37, Dec, 1969. 4 p, 7 fig, 2 tab.

Descriptors: Transmission lines, *Vibrations, *Failure (Mechanics), Extra high voltage, Fractures, *Fatigue (Mechanics), Conductors, Winds, *Bundled conductors, Dampers, *Oscillation, Instrumentation, Bending moments, Frequency, Field tests, Cracking, Stress.
Identifiers: Aeolian vibration, Galloping conductors, Outages, Electric conductors, *Transmission line hardware.

Lowering one subconductor in a horizontal bundle promises to ease sub-span galloping related to suspension hardware failures on twin-bundled 500-kv transmission lines. Unusual oscillations of conductors were observed during 40- to 50-mph winds approaching the line at near right angles over fairly level ground. Portland General Electric and Bonneville Power Administration engineers reached this conclusion after extensive investigations of suspension hardware failures on their lines within a year after installation. Vibration studies are discussed. (USBR)
W70-05227

EFFICIENCY IMPROVEMENT BY HIGH PRESSURE SHROUD AERATION OF TURBINES AND PUMPS ON A 75,000-HP TURBINE,
Dominion Engineering Works Ltd., Montreal (Quebec).
R. S. Sproule, and P. Koeller.
Amer Soc Mech Eng Publ 69-WA/FE-10, ASME Winter Annu Meet, Los Angeles, Calif, Nov, 1969. 8 p, 8 fig, 2 ref.

Descriptors: *Francis turbines, *Pump turbines, *Aeration, Cavitation, Hydraulic machinery, Compressed air, *Efficiencies, *High pressure, Test procedures, Automatic control, Instrumentation, Noise reduction, Turbine parts, Peaking capacities, Losses, Field tests, Flow, *Turbines, *Pumps, *Centrifugal pumps.
Identifiers: *Turbine efficiency, Test results, Foreign testing, Canada.

Shroud drag in a Francis turbine is a source of more than 1% efficiency loss. In a high head pump, shroud drag can consume 5% of the power input. Efficiency losses can be reduced by rotating the shrouds in air instead of in water. Many relative efficiency measurements were performed on a 75,000-hp Francis turbine at 900 ft head. High-pressure shroud aeration produced an efficiency increase as high as that calculated for shroud drag reduction. Above and below the best efficiency load, the injected air caused additional efficiency improvement, 50% more than the recoverable shroud drag losses. Aeration reduced the noise level, particularly at off-peak efficiency operation which Francis turbines tend to be noisy. Shroud aeration causes a decrease in turbine flow resulting in water saving for a longer peaking capability. Using aeration in a pump-turbine plant will produce approximately 1.5% more peaking energy with about 1.5% less energy input. (USBR)

W70-05229

OVERHEAD-LINE OSCILLATIONS AND THE EFFECT OF AERODYNAMIC DAMPERS,
Central Electricity Generating Board, Leatherhead (England).
J. C. R. Hunt, and D. J. W. Richards.
Proc Inst Elec Eng (Engl), Vol 116, No 11, p 1869-1874, Nov 1969. 6 p, 6 fig, 1 tab, 11 ref, 2 append.

Descriptors: *Transmission lines, *Dampers, Oscillation, *Winds, Wind velocity, Vibrations, Vibration suppressors, *Conductors, Wind tunnels, Bundled conductors, Ice, Testing, Energy, Energy dissipation, Foreign research.
Identifiers: *Aeolian vibration, *Galloping conductors, Aerodynamic forces, Wind direction, Amplitude, Great Britain.

An attempt is made to further the understanding of aerodynamic effects in large-scale vertical oscillations of overhead lines, usually referred to as galloping. The energy per cycle dissipated by the aerodynamic drag is calculated, and then, assuming that the lift coefficient of the cable is less than some measured maximum value, the maximum possible amplitude of oscillation is found for a given wind speed. The theory gives a plausible value of minimum wind speed at which clashing of conductors can occur, and a physical explanation for the given amplitude reached. The theory was used for estimating the effect of aerodynamic dampers in reducing the amplitude of galloping. Such dampers have been used in Canada, but the theory justifying the use appears inadequate. The method of calculation estimates the minimum effect such dampers can have. The performance of some cylindrical dampers proposed for use on twin lines where pairs of cables are suspended about 0.3 m apart is examined. (USBR)
W70-05238

GOPHER DAMAGE TO BURIED CABLE MATERIALS,
Bell Telephone Labs., Inc., Murray Hill, N.J.; and Bureau of Sport Fisheries and Wildlife, Denver, Colo.
For primary bibliographic entry see Field 08G.
W70-05240

8D. Soil Mechanics

EFFECTS OF VIBROFLOTATION ON CLAYEY SANDS,
Webb (Desmond L.) and Associates, Durban (South Africa).
Desmond L. Webb, and R. Ian Hall.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM6, p 1365-1378, Nov, 1969. 14 p, 11 fig, 1 tab, 13 ref, 3 append.

Descriptors: Alluvial deposits, Aeolian soils, Compaction, Compaction equipment, Compaction tests, Borings, Effects, Fines, Field tests, *Foundations, Loose soils, Penetration resistance, Penetration tests, Penetrometers, Settlement (Structural), *Soil compaction, Soil density, Soil mechanics, Saturated soils, Sands.
Identifiers: Vibratory compaction, *Vibroflotation, In situ tests, Foreign testing, South Africa.

Significant increases in density can be achieved in loose silty and clayey sands containing up to 30% clay by vibroflotation. Results are not as good as in clean sands, and vibroflotation might reduce the strength of clays or dense clayey sands in the subsoil. Field data are presented for 5 different saturated sandy materials from 3 sites. Satisfactory results were obtained using the static cone penetrometer for checking the effectiveness of vibroflotation during preliminary tests and for subsequent compaction control. When crushed stone fill (instead of sand) is added to the vibroflot crater, compaction of saturated clayey sands is improved, but the amount of compaction and the zone of influence of the vibroflot decrease with increasing clay content. The method of superimposing the effects of adjacent vibroflots, given by D'Appolonia, to predict compaction is valid for clayey sands. Using the average cone-penetration resistances to predict settlements after vibroflotation leads to overly conservative values. (USBR)
W70-05223

ROCKFILL DAMS AND ASPHALT CONCRETE.

Transl from German, Bur Reclam Transl 831, Dec, 1969. 16 p, 5 fig, 1 tab, 9 ref. Die Bautech, Vol 46, No 10, p 331-335, 1969.

Descriptors: Dam design, Dam construction, *Rockfill dams, *Asphaltic concrete, Dams, Waterproofing, Construction materials, Earth dams, Rock properties, Bituminous materials, Seepage, Construction, Slopes, Slope stability, Inspection, Maintenance.
Identifiers: *Dam facings, Dam stability, Construction methods, Design improvements, Design practices, Asphalt membranes, Construction control.

Using asphalt concrete in constructing rockfill dams and similar structures is regarded by many engineers as an established method. Asphalt concrete is a reliable, durable, machine-produced material enabling designers to use quality to replace sheer bulk. Two factors favoring the selection of rockfill dams are: (1) using an inexpensive source of rock, and (2) increasing cost of waterproofing processes involving manual labor compared to the refinement of asphalt concrete techniques. When core or filter materials are costly or in short supply and the major part of a dam will be pervious materials, elimination of the impervious fill and use of asphalt concrete for the water barrier is indicated because steeper slopes can be used, fill materials can be placed with less zoning and in almost any weather, and the dam can be raised easily at a later date. Developments affecting design of fill-type dams and problems of estimating costs of designs that have limited precedent are discussed. A partial list of dams having asphalt concrete water barriers is given. (USBR)
W70-05226

THE SETTLEMENT OF UNDER-REAMED AND STEP-TAPER PILES,
Sydney Univ. (Australia).
H. G. Poulos.
Inst Eng, Aust. Civ Eng Trans, Vol CE11, No 1, p 83-87, Apr 1969. 5 p, 10 fig, 2 tab, 12 ref.

Descriptors: *Settlement (Structural), *Piles (Foundations), Friction piles, Step-downs, Pile bearing capacities, Foundations, Elastic theory, Foreign research, *Theoretical analysis, Behavior, Pile foundations, Pile friction.
Identifiers: Comparative studies, Australia, Bored piles.

A theoretical analysis based on elastic theory was made of the settlement behavior of incompressible under-reamed and step-tapered piles within a semi-infinite mass. Under-reamed piles settle less than uniform piles of equal shaft diameter. The settlement reduction is determined primarily by the diameter of the enlarged bulbs and by the total effective length of the bulbs. Step-taper piles settle more than uniform piles of equal butt diameter. The increase in settlement is dependent only on the ratio of the tip-to-butt diameter. For a given pile volume and length, under-reamed piles settle less than uniform piles, and uniform piles settle less than step-taper piles. (USBR)
W70-05236

THE PORE PRESSURE-STRAIN RELATIONSHIP OF NORMALLY CONSOLIDATED UNDISTURBED CLAYS. PART I. THEORETICAL CONSIDERATIONS. PART II. EXPERIMENTAL INVESTIGATION AND PRACTICAL APPLICATIONS,
Laval Univ., Quebec.
K. Y. Lo.
Can Geotech J, Vol 6, No 4, p 383-412, Nov 1969. 30 p, 13 fig, 2 tab, 41 ref, 3 append.

Descriptors: *Pore pressure, Pore water pressures, *Strain, Saturated soils, Theory, Stress, Consolidation, Soil compression tests, Effective stress, Soil mechanics, Stress-strain curves, Experimental data, *Clays, Soil tests, Mathematical analysis Triaxial compression, Bibliographies.
Identifiers: *Undisturbed soils, Strain rate, Triaxial tests, Undrained tests.

A review of current theories of predicting pore pressures in saturated clays is presented. Mathematical analysis shows that the pore pressure induced by shear may be expressed as a sole function of major principal strain. This approach eliminates the anomalies inherent in the stress theories for pore pressure. Experimental results on normally consolidated undisturbed clays of various sensitivities are analyzed. The pore pressure ratio-strain relationship for isotropically and anisotropically consolidated samples is independent of the magnitude of consolidation pressures, time of sustained stress, time of consolidation, and intrinsic anisotropy under plane strain and axially symmetric stress conditions. Pore pressures set up under plane strain conditions can be estimated from results of triaxial tests. The effect of strain rate was small for the clays tested, and became insignificant at large strains. The relevance of findings to practical problems is discussed, and some problems especially suited to the pore pressure-strain approach are presented. (USBR)
W70-05246

SEISMIC WAVE VELOCITY AS A MEANS OF IN-PLACE DENSITY MEASUREMENT, FINAL REPORT - PART 1 OF 2,
Iowa State Univ., Ames.
J. M. Hoover, J. M. Hogan, and R. L. Handy.
Eng Res, Iowa State Univ, Ames, 1969. 38 p, 22 fig, 2 tab, 12 ref.

Descriptors: Seismic studies, Seismic waves, Field tests, Dry density, *Field density, Laboratory tests, Test procedures, Testing machines, Quality control, *Soil density, Soil engineering, Soil mechanics, Soil moisture, Soil tests, Theory, Correlation analysis, *Moisture content, Optimum moisture content.
Identifiers: *In place density, *Seismic velocity, *Seismic refraction, In place moisture, Seismic tests, In situ tests, Testing equipment.

Use of the seismic refraction technique to determine in-place dry density of embankment soils was investigated. Laboratory studies involved correlation of seismic wave measurements with conventional dry density and moisture content measurements of several soils. Field seismic measurements were correlated to in-place moistures and densities. Seismic velocity versus moisture content curves for standard and modified Proctor compacted laboratory soil specimens are similar in shape to dry density versus moisture content curves, but peak with about 1.2 plus or minus 0.9% lower moisture content, the plus or minus entry indicating one standard deviation on the mean. The seismic velocity versus moisture content curves are very sensitive to compaction wet of optimum and are not applicable when the moisture content greatly exceeds optimum. Field velocities obtained in this study were too low for a reliable estimation of field density. Subsequent tests indicated a gradual reduction in velocity upon aging, apparently because of absorption of pore water into the expandable interlayer region of the clay. Seismic tests should be conducted immediately after compaction or the results become meaningless. (USBR)
W70-05247

DESIGN OF STABLE OPEN CHANNELS USING CRITICAL TRACTIVE-FORCE CONCEPT,
Texas A and M Univ., College Station. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-05298

8E. Rock Mechanics and Geology

DIFFICULT EXCAVATION AT CARLEY PORTER TUNNEL,
Dravo Corp., Gorman, Calif.
Paul J. Varello.
Preprint 1005, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 22 p, 8 fig.

Descriptors: *Tunnels, *Tunnel construction, Faults (Geology), Gunite, Groundwater flow, Tunneling machines, Shields, Grouting, Grout curtains, Chemical grouting, Chimneys, Sinkholes, Well-points, Tunnel failure, Core drilling, Earth handling equipment, Excavation, Methodology, Engineering geology, Tunnel linings.
Identifiers: Carley V Porter Tunl (Calif), Unstable ground, Squeezing pressures, *Running ground.

The Carley V Porter Tunnel, a part of the California Aqueduct, the main artery of the California State Water Project, is located 60 mi north of Los Angeles in the Tehachapi Mountain Range. The Porter Tunnel traverses a portion of the Tehachapi Range whose geology is dominated by the presence of the 2 largest fault systems in California: the San Andreas and Garlock. The tunnel is 25,075 ft long, has a driven diameter of 24 ft, and a finished diameter of 20 ft. The width of the faults varies from a few inches to hundreds of feet and much groundwater was generally present with the wider zones. Advanced from 2 headings, the tunnel was driven by a tunneling shield with a fabricated steel liner plate support system. Advances were made by jacking against the liner plate supports. Conventional drilling and shooting techniques were used. Because of unusually difficult tunneling conditions, the excavation will be about 16 mo behind schedule. Approximately 90% of the down time was the result of severe running and caving ground conditions, complicated by heavy groundwater flow into the tunnel. Difficulties in driving the tunnel and methods used in overcoming them are described. (USBR)
W70-05209

STRESS CONCENTRATION FACTORS FOR THE FLAT BOREHOLE END FOR USE IN ROCK STRESS MEASUREMENTS,
National Mechanical Engineering Research Inst., Pretoria (South Africa).
W. L. Van Heerden.
Eng Geol Int J, Vol 3, No 4, p 307-323, Oct, 1969. 17 p, 6 fig, 4 tab, 11 ref.

Descriptors: Stress, Stress analysis, Stress concentration, *Strain measurement, *Stress distribution, Strain, Stress relieving, *Boreholes, Strain gages, *Rock mechanics, Rocks, Poisson ratio, Rock properties, Photoelasticity, Models.
Identifiers: *Overcoring method, Borehole deformation gage, Foreign testing, Photoelastic stress-meters, South Africa, Rock tests.

Stress cannot be measured directly but can be determined only from measurements of its effects, notably deformation or strain. To determine the absolute stress in rock, strain relief measurements are often performed by overcoring a borehole containing electrical resistance strain gages or a photoelastic disc at the flattened end. If the elastic moduli of the rock are known, the stresses on the flat end of the borehole can be calculated; before the rock stress can be determined, the stress concentration around the flat end of the borehole in terms of stress concentration factors must be known. A photoelastic model study and uniaxial loading tests of different materials are described. From these tests, the stress concentration factors are determined for the flat end of a borehole drilled into the materials and in the model. Results show that one of the stress concentration factors is related to Poisson's ratio. (USBR)
W70-05216

EARTHQUAKE PREDICTION AND CONTROL,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07B.
W70-05218

THE COMPRESSIVE STRENGTH OF HARD ROCK,
National Mechanical Engineering Research Inst., Pretoria (South Africa).
Z. T. Bieniawski.
Tydskr Natuurwetensk, Vol 8, No 3/4, p. 163-182, Sept/Dec 1968. 20 p, 11 fig, 3 tab, 9 ref, 2 append.

Descriptors: *Compressive strength, Rocks, *Rock mechanics, Samples, Engineering geology, *Shape, *Rock properties, Laboratory tests, *Size, Quartzite, Sandstones, Experimental data, Cracking.
Identifiers: Uniaxial compression, Rock tests, South Africa, Foreign testing, Test results, In situ tests.

Knowledge of rock properties is essential if the behavior of the rock surrounding mining excavations is to be understood. Rockbursts, roof falls, stope closure, and scaling of working faces are influenced directly by the properties of the peripheral rock. Safe and economic design of mining excavation can be achieved only if reliable information is available on the strength characteristics of the rock. Because of predominance of compressive stresses in mining problems, determination of the compressive strength of rock is particularly important. The compressive strength of rock is not determined easily. Rock is not a perfectly homogeneous isotropic solid, but contains many discontinuities such as cracks, pores, and cleavage planes, directly influencing the properties of the material. Uniaxial compression tests show a reduction of 25% in strength for 5-in. cube and EX core specimens; constant strength for cube specimens larger than 5 in.; the same strengths for cylindrical, cubic, or prism specimens of equal volumes; and no affect on strength of specimens within the 0.33 to 2.00 width-height ratios and 1.0 to 3.8 length-width ratios. Practical implications are discussed. Laboratory strength data on hard rock offer realistic information for solving practical mining problems in hard rock. (USBR)
W70-05250

STABILITY OF TUNNELS UNDER ROCK LOAD,
L. V. Rabcewict.
Water Power, Vol 21, No 6, 7, 8, p. 225-229, 266-273, 297-302, June, July, Aug, 1969. 19 p, 41 fig, 22 ref.

Descriptors: *Tunnel construction, Tunnel failure, Tunnel design, Rock mechanics, *Tunneling, *Tunnel linings, Theory, Shear failures, Anchors, Theoretical analysis, Shear stress, Structural behavior, Bibliographies, Model tests, Flexible linings, Gunite, Tunnels, Deformation, Structural design, Stability, Foreign design practices.
Identifiers: *Austrian Tunneling Method, *Tunnel supports, Yielding, Austria, Concrete linings, Rock pressures, Stress relaxation.

The salient feature of the New Austrian Tunneling Method is a semirigid lining applied to the rock before it is damaged by loosening. The lining, designed to reach permanent equilibrium after adjusting to rearrangement forces, may be any material or combinations of materials suited to the purpose. Tunnels should be driven full face where possible in a minimum of time. Practical experience and theoretical investigations have proved that by using the method, rock surrounding a cavity can be transformed into an effective carrying member. Failure by shear is the only mode of collapse of a tunnel lining when the lining extends around the entire periphery of the tunnel section. Principles for designing linings based on failure by shear are explained and proved by model tests. Some theoretical analyses of the strength of linings and anchors are presented and a design method based on data collected on shear failure is discussed. The effect of contact between lining and rock on tunnel behavior is examined. A type of strengthening consisting of system anchoring combined with shotcrete, taking advantage of the property of rock to stabilize by yielding, is described. A tunnel and an underground powerhouse constructed in accordance with the New Austrian Tunneling Method are described. (USBR)
W70-05252

8F. Concrete

CONSTRUCTION PROCEDURES FOR LARGE-SCALE CONCRETE STRUCTURES FOR OCEAN ENGINEERING,
Santa Fe Poeroy, Inc.
Ben C. Gerwick, Jr.
Preprint 1053, Amer Soc Civ Eng Annu Environ Meet, Chicago, Ill, Oct, 1969. 29 p.

Descriptors: Construction, Submergence, *Underwater construction, *Marine engineering, Oceans, Concrete construction, Concrete technology, Concrete control, *Concrete structures, Prestressed concrete, Planning, Floating, Fabrication, Installation, Quality control, Underwater, Structures.
Identifiers: Construction control, *Construction methods, Construction practices, Concrete properties, Floating structures.

Concrete is the ideal material for large-scale floating and submerged ocean structures. Methods of launching, fabricating, assembling, and installing concrete structures for ocean use are described. Launching methods include: (1) sliding structures into the water on launching ways, (2) tidal floating, (3) drydock flooding, (4) basin flooding, (5) lowering from platforms, (6) barge flooding, (7) excavation of natural or artificial islands from beneath structures (sandjack method), (8) rolling into water, (9) collapsing platforms, and (10) construction afloat. Using concrete for ocean structures imposes stringent demands on quality, requiring the most advanced concrete technology and strict construction control. Advantages of prestressing are summarized and potentials of ferro-cement techniques and lightweight concrete are discussed. Methods of installation and sinking include: (1) casting-in-place, (2) bottom assembly, (3) assembly afloat, (4) prejoining sections, (5) external buoyancy tanks, (6) submerged lowering, (7) pull down, (8) buoyancy control by air or pressure, and (9) flooding. (USBR)
W70-05210

ROCKFILL DAMS AND ASPHALT CONCRETE.
For primary bibliographic entry see Field 08D.
W70-05226

PREPLACED AGGREGATE CONCRETE FOR STRUCTURAL AND MASS CONCRETE,
American Concrete Inst., Detroit, Mich.
Donald L. Houghton, Albert B. Crosby, and Howard E. Willey.
Amer Concr Inst J Proc, Vol 66, No 10, p 785-797, Oct, 1969. 13 p, 4 fig, 2 tab, 12 ref.

Descriptors: Concretes, *Concrete placing, *Concrete technology, Mass concrete, Concrete construction, Concrete control, Concrete finishing, Concrete mixes, Standards, Grouting, Portland cements, Aggregates, Coarse aggregates, Quality control, Curing, Injection, Underwater construction.
Identifiers: Structural concrete, Concrete properties, *Prepacked concrete, Grout mixes.

Preplaced aggregate concrete is formed by filling the forms with clean well-graded aggregate and injecting grout into the voids of the aggregate mass. This method of placing concrete is adaptable to underwater construction, concrete and masonry repairs, and new structures where placement by conventional methods is difficult or where concrete

of low volume change is required. Preplaced aggregate concrete contains more coarse aggregate than conventional concrete, resulting in less drying shrinkage and a slightly higher modulus of elasticity. Cements, admixtures, pozzolans, aggregates, and grout mix proportioning are discussed. Concrete forms, coarse aggregate placement, grout pipe systems, mixing and injection, finishing, curing, and quality control methods are described. ASTM and Corps of Engineers Standards are listed. (USBR)
W70-05228

CHEMICALLY PRESTRESSED CONCRETE,
Samuel Aroni, Vitelmo Bertero, and Milos Polivka.
J Prestressed Concr Inst, Vol 13, No 5, p 22-35, Oct, 1968. 14 p, 4 fig, 21 ref.

Descriptors: *Portland cements, Prestressing, Precast concrete, Concrete structures, *Prestressed concrete, *Concretes, Concrete mixes, *Concrete technology, Durability, Workability, Concrete pipes, Composite structures, Beams (Structural), Shell structures, Bibliographies.
Identifiers: Cement chemistry, *Expanding cements, Concrete slabs, Calcium sulfoaluminate, *Chemical prestressing.

The peculiar features of self-stressing expansive cement concrete are presented, and structural problems and special techniques with chemical prestressing are reviewed. The report is based upon experiences with Type K cement produced at the Engineering Materials Laboratory of the University of California at Berkeley, but the results may be qualitatively applied to other types of expansive cements. Type K cement is a mixture of portland cement (low in tricalcium aluminate), with anhydrous calcium sulfoaluminate as the expansive component. Composition of the cement, nature of expansion, creep, shrinkage, curing, restraint, and workability are discussed. Chemically prestressed concrete appears promising for use in large prefabricated structural units, composite elements, and prefabricated elements requiring low optimum prestress such as pipes, columns, and surface elements. Materials and structural problems needing additional research are listed. (USBR)
W70-05230

8G. Materials

GOPHER DAMAGE TO BURIED CABLE MATERIALS,
Bell Telephone Labs., Inc., Murray Hill, N.J.; and Bureau of Sport Fisheries and Wildlife, Denver, Colo
R. A. Connolly, and R. E. Landstrom.
Mater Res Stand, Vol 9, No 12, p 13-16, 43, 46, Dec 1969. 6 p, 7 fig, 4 tab, 11 ref.

Descriptors: *Electric cables, *Damages, *Gophers, Rodents, Copper, Rodenticides, Communication, Corrosion, Animal behavior, Epoxy resins, Lead (Element), Asbestos, Asphalt, Polyethylenes, Vinyl plastics, Glass fibers, Rubber, Test procedures.
Identifiers: *Buried cables, Underground cables, Corrosion resistant alloys, Test results.

The pocket gopher has long been known to damage buried wire and cable. Laboratory tests with the plains pocket gopher were conducted to determine the resistance of various materials and wire and cable configurations of gopher attack. Of the organic materials tested, only epoxy-fiber glass offered protection against these animals. All sheet metals in thicknesses of 0.005 to 0.010 in. (except aluminum and lead) offered complete protection. The size and core construction of the wire and cable influenced damage. The results are in line with field experience. Test procedures are described and results evaluated. The degree of damage to unarmored wire and cable is inversely proportional to the diameter. Armored cables offer gopher protection to the cable cores, but once the armor is exposed, the corrosion resistance of the armor becomes important. Contrary to accepted beliefs, cables in field services may experience gopher attacks causing significant damage as long as 6 yr after installation. (USBR)
W70-05240

8I. Fisheries Engineering

SIMPLE STREAM TANK SIMULATING A RAPIDS ENVIRONMENT,
Manitoba Univ., Winnipeg. Dept. of Zoology.
For primary bibliographic entry see Field 07B.
W70-05096

FISHERIES AND GAME: STATE BOARD.
For primary bibliographic entry see Field 06E.
W70-05447

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

INVENTORY OF WATER RESOURCES RESEARCH CONDUCTED IN MINNESOTA, 1963 THROUGH 1968.
Minnesota Univ., Minneapolis. Water Resources Research Center.

Available from the Clearinghouse as PB-190 440, $3.00 in paper copy, $0.65 in microfiche. Minnesota University Water Resources Research Center Bulletin 12, August 1969. 57 p, 9 fig, 6 tab, 2 append. OWRR Proj No A-999-MINN.

Descriptors: *Research and development, *Water resources development, *Minnesota, *Research facilities, Laboratories, Projects, Research equipment, Contracts, Allotments, Grants, On-site investigations, Planning, Technology, Bibliographies, Reviews.
Identifiers: Water resources research.

An inventory of water resources research conducted in Minnesota during the 6-year period 1963-68 is presented. The information concerning number and kinds of research, and man-years of research effort should: (1) provide a better understanding of past research activities of the University of Minnesota, State and private Colleges, and Federal, State, local and private organizations in Minnesota; (2) provide a better understanding of the role of the Water Resources Research Center in the total research effort in Minnesota; and (3) assist research administrators and funding agencies in making future allocations of manpower and funds for research efforts. (Knapp-USGS)
W70-05114

9D. Grants, Contracts, and Research Act Allotments

INVENTORY OF WATER RESOURCES RESEARCH CONDUCTED IN MINNESOTA, 1963 THROUGH 1968.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 09A.
W70-05114

STORM AND COMBINED SEWER DEMONSTRATION PROJECTS, JANUARY 1970,
Federal Water Pollution Control Administration, Washington, D.C. Div. of Applied Science and Technology.
For primary bibliographic entry see Field 05G.
W70-05467

10. SCIENTIFIC AND TECHNICAL INFORMATION

PROGRESS IN DEVELOPING AN INFORMATION SYSTEM TO DISSEMINATE CURRENT WATER RESOURCE SCIENTIFIC INFORMATION,
Water Resources Scientific Information Center, Washington, D.C.
Raymond A. Jensen, and Logan O. Cowgill.
Available from the Clearinghouse as PB-189 488, $3.00 in paper copy, $0.65 in microfiche. Proceedings of 13th Annual Conference on Water for Texas, Nov 25-26, 1968, Texas A and M University, College Station, p 24-28, 1968, 5 p. OWRR Project A-999-TEX.

Descriptors: *Documentation, *Abstracts, *Bibliographies, *Hydrology, *Water resources, Hydraulics, Groundwater, Surface waters, Technical writing, Reviews, Surveys, Information retrieval, Data collections, Data storage and retrieval, Hydrologic data, Publications.
Identifiers: *Water Resources Scientific Information Center, U. S. Department of the Interior.

The purpose, functions, origin, and history of the Water Resources Scientific Information Center, U.S. Dept. of the Interior, are reviewed. WRSIC's responsibility is to serve as a center for national water resources information, initiate activities to fill gaps in current information services, and make support agreements with water resources agencies. The national information system should include selection of literature by specialist organizations, dissemination services, and liaison with other national information systems. Service agreements have been negotiated with Federal agencies, Water Resources Research Institutes, Federal Basin Commissions, and other organizations. Center of competence agreements have been negotiated for special subject areas. Selected Water Resources Abstracts is the processed output of the centers of competence and the water resources agencies, and is produced for WRSIC by the Clearinghouse for Federal Scientific and Technical Information. Each issue has indexed abstracts as well as author, subject, organizational, and accession number indexes. An annual accumulative index appears at the end of the year. Services not derived from the information base include the Water Resources Research Catalog, selected bibliographical publications (such as a Permuted Title Index to Water Resources Journals for the Year 1967), and program development and evaluation studies. WRSIC is studying and identifying other primary and secondary information sources, particularly periodic journals in sociology, economics, and law, as well as other major abstracting services. (See Vol 2, No 16, Field 6B, W69-06790). (Knapp-USGS)
W70-05458

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